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Science and Learning in Distress

IN the early summer of 1933, the Academic Assistance Council was founded, under the presidency of Lord Rutherford and with the active support of many distinguished men of science and other scholars, to find places in the fabric of world science and world scholarship for men and women driven from their countries and their work for racial, religious or political reasons. Such persecution was not new, even in the very recent past : it had happened again and again in Russia and was still happening : but the scale of its application in Germany and the distinction of its victims demanded immediate help. The Academic Assistance Council had no partisan, political or national bias. Indiscriminate relief was to be no part of its work. Its purpose was to act as a link between the scientific workers and other scholars displaced and the universities and research institutions of the world, so that their exceptional abilities exceptionally trained—to quote the noble declaration of the Council's founders—should not be lost.

It was hoped that the emergency would pass, but as the years went on, intolerance and persecution grew ; no end was in sight. The Academic Assistance Council took permanent shape therefore as the Society for the Protection of Science and Learning : its wider purpose was now to act as a clearing house of information and advice to exiled scholars, and to persons, institutions and departments desiring to help them ; its narrower purpose—within the limits of its resources—to offer temporary maintenance grants and other aids to re-establishment. The spread of 'racial' doctrine to Italy, the consequences in Austria and Czechoslovakia of the political events of 1938 and their reactions in neighbouring countries, the continuation of civil war in Spain, the extreme xenophobia of the U.S.S.R., and recent events in Germany, all these have added to the need, for information and advice on one hand, for direct assistance on the other. When a ship is in distress no sailor, and few landsmen, will not want to go to its help.

The Society has just issued its annual report, from which it appears that a widespread appeal is shortly to be issued : for funds on one hand ; for interest and sympathy, through membership, on the other. The problem has been complicated and enlarged by the events of 1938, but the Society has not turned aside from its original purpose and principles. It exists, not to advertise a particular point of view, but to do an honest job of work in seeing that ability and experience in science and scholarship are not wasted. It does not, it cannot, disregard human values ; but its charity is devoted to those who can contribute to the common stock of learning. It stands for the brotherhood of scientific endeavour, regardless of race and creed and politics : and it stands for it, not by passing pious resolutions or by putting out disguised political propaganda, but by trying to help colleagues in their need. Foreign scientific workers are found work which restores their self-respect and makes others realize their value in their common task ; so that, not seldom, they become self-supporting. From the start, however, the Society has done its best to avoid any unfair competition of exiled scientific workers and other scholars with those in the countries where they are seeking refuge, and has realized, and urged, that in the long run such competition is as little in

the interest of the exiles as in that of scientific workers as a whole.

The Society must maintain its authority and integrity in the face of its increasing task. In Germany alone, fourteen hundred university teachers and research workers have been displaced, many of them among the most distinguished in the world; not merely debarred from teaching and research, they are not allowed to make a living at all. More than four hundred Austrian men of science and other students have been displaced, and of these only about a hundred have been able to leave the country. The full effects of the 'racial' policy in Italy and of the partition of Czechoslovakia have yet to be felt; Spain, from which scholars of both parties have been helped, is still no place for tolerant, sensitive academic people; and the U.S.S.R. has disappointed our hopes by turning out those who originally found work and refuge there.

Caution in the circumstances must often seem intolerable to humane men, but the Society's stringent caution in accepting responsibility bears fruit. Work has been found permanently for about 550 scholars in thirty-eight different countries, from Australia to Venezuela; for about 330 temporarily in twenty-five countries. Turkey, which is building a new civilization, has welcomed numbers of the displaced university men.

In November 1937, the Society called an informal conference at Oxford of representatives of European universities, and the ideal of an international exchange for information and employment came nearer to realization. The Society's register of exiled scholars is now unique, authoritative and international. Any academic or research institution can have the benefit of its records of those "exceptional abilities exceptionally trained", lost to their own countries, but not, if the Society can prevent it, to the service of knowledge anywhere else in the world.

Funds and interest are, however, an imperative need; first, for the work of administration, information and advice; secondly, for direct help in human emergency. It is to be hoped that the wider educated public, particularly in the English-speaking countries, will respond generously to the appeal for support which the Society is making, and come to the help of science and learning in distress.

Serialism and Immortality

The New Immortality

By J. W. Dunne. Pp. 157. (London: Faber and Faber, Ltd., 1938.) 3*s*. 6*d*. net.

THIS little book is intended to supply the general reader with a more or less popular account of the theories about time and the self which Mr. Dunne has developed in considerable detail in his previous works, "An Experiment with Time" and "The Serial Universe". Mr. Dunne thinks that these theories are entailed by certain quite general facts about time and change, on one hand, and about self-consciousness on the other. The former reduce to the linguistic fact that we talk of future events as 'becoming real' or 'coming into existence', of past events as having 'ceased to be real' or having 'passed out of existence', and so on. The latter reduce to the linguistic fact that each of us uses expressions like 'my self' and 'your self', which seem to imply, in the case of each of us, the existence of an owned self and an owning self and an 'I' which knows them both and sees that the one owns the other.

Mr. Dunne assimilates this latter distinction with another, about which he makes much ado. This is the distinction between a recording instrument, for example, a magnetometer; a body which influences it in virtue of one of its properties, for example, a magnet; and the reading which the instrument records when thus influenced. Mr. Dunne thinks that we are liable to confuse the reading of the instrument with the agent which causes the instrument to record this reading; and that many important consequences follow, on which the distinction throws a flood of light. I find it hard to believe that anyone except an extremely eminent mathematical physicist engaged in writing extremely bad philosophy ever would make such a gross mistake.

Taking these linguistic expressions literally and seriously, Mr. Dunne quite correctly infers that he is committed to an endless series of 'times' and an endless series of 'observers'. He also infers that each term in the series of 'times' reduces all the previous terms to additional dimensions of *space*. Time would be the last term of a series which, from the nature of the case, would have no

last term. This appears to me to be a plain *reductio ad absurdum* of Mr. Dunne's theory. He disguises it from himself by talking airily about "the observer at infinity" and by palpably false analogies with infinite series which have upper limits.

Mr. Dunne thinks that his theory is supported by certain empirical facts about dreams. He also claims to show that the characteristic features of the special theory of relativity and the quantum theory are necessary consequences of his serial theory. I have never been able to follow this deduction even in the full exposition of it in "The Serial Universe"; one part of it appears to depend on a juggle with the square root of minus-one based on a misapplication of Argand's diagram. I should think that the condensed form of it in the present work would be completely unintelligible to all readers.

The main object of this book is to expound and illustrate a theory of immortality which is closely bound up with the serial theory of time and the self. The first-order observer collapses with the death of the body, but the higher-order observers are unaffected. Although they can get no more sensory experiences, they retain and can rearrange, in any order they like, those sensory experiences which were obtained before death by use of the first-order observer. Mr. Dunne explains and illustrates this theory very well by analogies with music and with typewriting. Even if Mr. Dunne's general theory were intelligible and true, he produces no cogent positive reason for holding that the higher-order observers would survive the death of the body. He is content to argue, by what seem to me to be quite unconvincing analogies, that the burden of proof lies on anyone who doubts this. However this may be, if the theory is self-contradictory, as I believe, it can lend no support to any conclusion. C. D. BROAD.

Birds of Britain

The Handbook of British Birds

By H. F. Witherby (Editor), Rev. F. C. R. Jourdain, Norman F. Ticehurst and Bernard W. Tucker. Vol. 2 (Warblers to Owls). Pp. xiii + 352 + 30 plates. (London: H. F. and G. Witherby, 1938.) 21*s.* net.

THERE are to be five volumes of the "Handbook of British Birds", and the second volume which has just been published deals with the warblers, the thrush family, wheatears, whinchats and redstarts, nightingale and robin, hedge-sparrow and wren, the water ousel, the swallow and the swift family, the nightjar and the kingfisher, the woodpeckers and the wryneck. The cuckoo and its strange habits are described, and there is a series of photographs of a young cuckoo in the act of throwing an egg out of the nest. The latter part of this volume is given up to the owls—the snowy and the short eared owls, the little owl, and others.

It is stated that the reception of the first volume has been most gratifying, and the second volume is fully up to its high standard. The illustrations are clear, and the coloured plates especially helpful. A series of valuable diagrammatic maps are incorporated in the text. H. F. Witherby has compiled three of these maps. The first shows the breeding distribution in the British Isles of the reed warbler, the second shows the nesting distribution of the greater spotted woodpecker, and the third the breeding distribution of the little owl in Britain. It is, by the way, of interest to know that a full inquiry has proved that this alien owl, introduced in Britain during the nineteenth century, is not so destructive as is generally supposed; but Mr. R. M. Lockley has shown that they work great havoc among storm petrels when they take up their quarters on islands where the petrels are nesting.

Other maps in the book show the breeding distribution of the nightingale (N. F. Ticehurst) and the recovery in Africa of swallows ringed in Europe (E. Schüz).

In an interesting map compiled by H. N. Southern is shown the northward migration of the swallow through Europe during spring and early summer. Mr. Southern has found that swallows make the northward flight from Spain to the north of Norway, a distance of more than two thousand miles, in about seventy-seven days, at a fairly steady rate. The average date of the arrival of the swallow in Spain and Italy is March 15 and, in the north of Scandinavia, June 1. It is to be hoped that Mr. Southern may later compile a similar map showing the northward migration of the swift, and that he may be able to explain the late northward movement of these birds, which the reviewer has seen flying northward at a great height over the Cairngorms in mid-June, and again passing north-east over the Isle of Skye (where the swift does not nest) at the same time of year.

Presumably these swifts are travelling to the most northerly limit of their breeding range.

There is also in this volume a helpful chart of the song periods of British birds, compiled by H. G. Alexander.

Not the least admirable feature of these "Handbooks of British Birds" is their accuracy, a standard difficult to attain to as new species and subspecies of birds are yearly being discovered. It is a number of years since the Hebridean thrush was separated as a distinct species from the British song thrush. In the Isle of Skye, in the reviewer's experience, the range of the Hebridean thrush is interesting. In the treeless district of the north-west of Skye, which is only sixteen miles from the nearest of the Outer Hebrides, the resident thrush appears to be the Hebridean thrush. These birds are very tame and can be watched closely. But in the east and south of Skye, in the woods and gardens of Portree, Broadford and Sleat, the song thrushes appear to be an intermediate form between the British song thrush and the Hebridean song thrush.

In the volume under review the song period of the Hebridean song thrush is stated to be from February until the end of June. This rather under-estimates the duration of song as the bird is habitually in full song during the first three weeks of July and sometimes, when it nests late, is heard in full song until mid-August, singing, as is its custom, from a house-top or from a wall or from a patch of whins. The song of the Hebridean thrush is softer and less assertive than the song of the British song thrush, and the reviewer has noticed that particular phrases are less often repeated.

A large immigration of thrushes, not of the Hebridean form, takes place each October to the north-west of Skye, and the birds appear to remain, along with immigrant blackbirds, throughout the winter.

In reading the records in this book one is struck by the number of rare birds recorded from Fair Isle, that small and lonely island lying in the Atlantic midway between Orkney and Shetland. Here such rare British visitors as the rock thrush, Eversmann's warbler, red-rumped swallow, needled-tailed swift, red spotted bluethroat and white spotted bluethroat—to name only a very few—have been recorded. It is seldom that an island on the track of migrating birds has an accurate observer residing on it, but Mr. Stout, the postmaster of Fair Isle, is an enthusiastic and competent ornithologist.

It is necessary to say, in recommending this latest volume in this practical Handbook series, that it is a book which the amateur bird enthusiast as well as the expert cannot well be without, if she or he is to remain up to date in bird-watching and in bird-lore. S. G.

Theoretical and Practical Organic Chemistry

(1) Organic Chemistry
By Prof. Frank C. Whitmore. Pp. x+1080. (London: Chapman and Hall, Ltd., 1937.) 40*s*. net.

(2) Systematic Organic Chemistry:
Modern Methods of Preparation and Estimation. By Prof. William M. Cumming, Dr. I Vance Hopper and Prof. T. Sherlock Wheeler. Third edition, revised by William M. Cumming and I. Vance Hopper. Pp. xxvi+548. (London: Constable and Co., Ltd., 1937.) 25*s*. net.

(3) Laboratory Practice of Organic Chemistry
By Prof. G. Ross Robertson. Pp. xi+326. (New York: The Macmillan Co., 1937.) 10*s*. net.

(1) PROF. WHITMORE has written "a one volume reference-text . . . designed for those already possessing reasonable knowledge and experience in organic chemistry". It is certainly a long time since an author has claimed to treat "the whole of organic chemistry in a single volume" of rather more than 1,000 pages. Of the book 0·57 is given to the description of the aliphatic compounds, 0·07 to the alicyclic compounds, 0·17 to the aromatic compounds, 0·08 to the heterocyclic compounds and 0·11 to the index which comprises no less than 122 pages. This index has a character of its own; under 'linkage', for example, references to twenty-three different types are given. It is not only an index but also a special type of dictionary of organic chemistry. No organic chemist will be surprised that Prof. Whitmore has been occupied during eight years in making this most readable and, so far as a reviewer can test it, accurate and up-to-date compilation.

Whether the book will satisfy the majority of organic chemists would appear to be doubtful. In certain directions, the subject matter is adequate; in others, it is otherwise. Only one synthesis of indigo is referred to in outline, in two and a half lines; alizarin and camphor are likewise summarily dealt with. These are examples of isolated

and fundamentally important compounds with which the author may expect his readers to be already acquainted. Taking a group of compounds, if the carbohydrates and glycosides can be successfully discussed in forty-one pages, Prof. Whitmore's treatment is a model of compression.

The successful learning of organic chemistry largely depends on the manner of use of original literature by the student. In many cases, Prof. Whitmore gives references only to the name or names, usually not more than two, of the worker or workers whom he judges to be outstanding. This is not wholly satisfactory and many will disagree with the author's opinion. Probably to save space, references to original literature are not given, and it is interesting to know that an American author considers "The Annual Reports of the Progress of Chemistry" published by the Chemical Society in London worthy of repeated reference "because they offer excellent summaries".

Prof. Whitmore's "Organic Chemistry" may be styled an excellent summary. If this modern text-book be compared with the much older and almost classical "Lehrbuch der Organischen Chemie", of which Victor Meyer and Paul Jacobson were the original authors, many deficiencies appear, and one may regret that no one seems inclined nowadays to emulate the work of these two famous chemists and those who have attempted to bring their work up-to-date.

(2) The second volume under notice is a practical book deserving of high commendation. It has a reputation of fifteen years and this is the third edition. In plan and contents it is in the front rank of text-books for the successful training of the students in the practical side of organic chemistry.

After two chapters dealing adequately with the most general types of reactions in organic chemistry, apparatus and methods, including details regarding the determination of constants of pure materials and modern methods for the separation of mixtures, the preparation and reactions of classified organic compounds are fully illustrated. Then follows a section dealing with the electrolytic preparation of typical compounds, the preparation of pure compounds from naturally occurring materials and of stereoisomeric compounds, which indicates something of the comprehensive character of the practical training outlined by the authors.

It would be difficult to improve on the section dealing with quantitative methods. The authors fully justify the inclusion of macro-, micro- and hemi-micro methods of analysis of organic compounds, and it is clear they deprecate the tendency in certain schools to omit exercises in ultimate analysis since micro methods have come into common use and are now to a great extent carried out by professional analysts. It might add to the value of this section if other alternative methods of determining, say, bromine and chlorine were introduced in later editions.

A useful list of reactions of certain important types of organic compounds and a comprehensive index complete this book, which brings successfully the work of the lecture-room into the laboratory. It would appear that the only drawback is the omission of the year of the volume from references to original literature and specialized text-books. Particularly for students, the 'year' is more important than the actual volume number, the use of which has now been abandoned by the Chemical Society.

(3) Prof. Ross Robertson's "guide to practical organic chemistry" is much smaller than that by Prof. Cumming and his colleagues, and both books are departures from the older books on the subject which are largely detailed working recipes.

One third of the present volume is taken up by a critical discussion of the principles of manipulation and the elementary physical chemistry on which depends the separation of solid and liquid organic compounds from mixtures. The remaining two thirds of the book is devoted to laboratory experiments on the preparation and properties of organic compounds. These are not intended to be comprehensive and have been discriminately selected with the view of carrying out a limited number of typical reactions rather than a large number of those having little relationship to each other. Other more comprehensive books are referred to including that by Prof. Cumming and his colleagues, and this portion of the book is particularly well written. Each typical exercise is preceded by a theoretical statement briefly summarizing important details concerning the physical and chemical properties of the particular substance and the best conditions for realizing the reaction or reactions concerned. Then follow the details of the actual preparation and the isolation of the product, a list of other analogous preparations with references, and finally a number of questions arising out of the methods of procedure which have been adopted in this and analogous cases.

There is a brief account of the qualitative analysis and identification of certain types of organic compounds, but the author has omitted any reference to their ultimate quantitative analysis. This could easily be included in a subsequent edition if the author wishes to make the course he outlines even more useful than it is already for training for original investigation.

The book is well printed with clear diagrams. Altogether, it can be recommended as a useful critical treatment of the principles of practical organic chemistry.

CHARLES S. GIBSON.

Plant Ecology

Plant Ecology
By Prof. John E. Weaver and Frederic E. Clements. Second edition. (McGraw-Hill Publications in the Botanical Sciences.) Pp. xxii+601. (London and New York: McGraw-Hill Book Co. Inc., 1938.) 30*s*.

THE first edition of this text-book was published in 1929 with 520 pages. The short preface to the new edition, dated January 1938, points out in concise phrases some of the more important advances in plant ecology made in less than a decade. The wide acceptance of succession as a basic principle in the study of vegetation has led to a better understanding of invasion, ecesis, and the stabilization of climax vegetation. The use of plant species and plant communities as indicators, the changed concept of xerophytism, and improved methods of studying the environmental factors are among the advances which are enabling the ecologist to grasp the complex interactions of plant life. Particularly important to the plant ecologist are the new conceptions of the vast importance of climate and vegetation in soil development. On the applied side, too, plant ecological studies are making great advances. Erosion, largely due to man's misuse of the natural plant cover, has been realized as a problem of national and international importance.

Ecology suffers in its presentation from an inherent drawback which is not so evident in some other biological subjects. It depends very much upon taxonomy, and floras differ greatly in different parts of the world. The synecologist has to name and ecologically to describe and classify the species components of the vegetation with which he is concerned. It follows that much of his description can only be followed, or at least fully appreciated, by biologists familiar with the local flora.

In text-books, the general principles have to be exemplified by reference to plants the very names of which may be new to foreign readers, many of whom will certainly have no personal acquaintance with the plants themselves. An ecological text-book has, therefore, its greatest value in one country—that from which the author takes his examples. The authors of the work here reviewed take the vast majority of their examples from North American vegetation. While it is true that they have not overburdened their text with plant names, and illustrate the book freely with photographs and other reproductions, most of the species mentioned, and a fair proportion of the genera, will be unknown to most British readers. Differences of size, climate, physiography, and economic history between the United States and the British Isles also hinder this book from being an ideal text-book for use in the latter. On the other hand, the enthusiasm of the authors for their subject, the very full statement of general principles, and the comprehensive bibliography (of 1035 references) must make the work extremely valuable for reference. It is, so far as Great Britain is concerned, a book for the teacher rather than for the school or college student, and as such it can be heartily recommended. W. B. TURRILL.

Iris Patterns and their Inheritance

Structural Variations of the Human Iris and their Heredity
with Special Reference to the Frontal Boundary Layer. By Dr. Viggo Eskelund. Pp. 243. (Copenhagen: Nyt Nordisk Forlag Arnold Busch; London: H. K. Lewis and Co., Ltd., 1938.) 21*s*. net.

THE laws of inheritance of blood groups and types are now so well established that in certain cases paternity can be definitely excluded. Dr. Eskelund believes that the various patterns of iris found in man could also be classified on an hereditary basis, and eventually perhaps provide equally good or even better evidence of paternity.

In a laborious study of photographs of the living iris in 154 subjects conducted under the auspices of the P. Carl Petersen Foundation at the University of Copenhagen, he has arrived at certain preliminary conclusions which will interest without convincing most of his readers. He holds that iris pattern can be definitely classified into types. To achieve this, one must take the anatomical conditions of the various regions (for example, anterior and posterior layers of the stroma, uveal border, presence or absence of crypts, depth of colour and distribution of chromatophores, etc.) and arrange them under headings of combinations of variables.

The author's description of the various types is rendered slightly difficult for English readers by

the use of an unusual terminology. For example, his "frontal boundary layer" is what we are accustomed to call the anterior layer and his "scratches" are small crypts. The photographs are beautifully reproduced, but it would be easier to follow the suggested classification if Dr. Eskelund had used a higher magnification in examining the eye before photographing it. It also seems doubtful whether he has described anything like the possible number of types. There seems, for example, to be little or no reference to racial differences, which are often great, or to the effects of racial interbreeding.

It will certainly be generally admitted that there is some hereditary factor influencing iris pattern. Indeed this has been shown already by the work at the Galton Laboratory on both normal and pathological irides in man and animals. To what extent, however, reliance can be placed on a classification, necessarily rough, to subserve any medico-legal purpose is uncertain. It is probable that iris pattern is as individualistic as finger-print pattern and it might prove to have an even greater identification value, since it cannot be obliterated. Its value in proving heredity must, however, remain doubtful until many more pedigrees of several generations have been examined in different races.

Fossil Gastropods

Handbuch der Palãozoologie
Herausgegeben von O. H. Schindewolf. Band 6: Gastropoda. Lieferung 1, Teil 1: Allgemeiner Teil und Prosobranchia. Pp. viii + 240. (Berlin: Gebrüder Borntraeger, 1938.) 45 gold marks.

ALTHOUGH students of most nationalities are now well provided with text-books of palæontology, no comprehensive work of reference giving a complete survey of existing knowledge of the subject has appeared since the publication of Zittel's famous "Handbuch der Palæontologie" (1876–1893). To remedy this deficiency a new "Handbuch" (a term the connotation of which appears to have undergone a process of evolution) is now in course of preparation under the general editorship of Prof. O. H. Schindewolf. The collaboration of nearly fifty specialists, belonging to several nationalities, has been secured for this work, which it is proposed to publish in twenty volumes, the majority of which will consist of several *Lieferungen*. The appearance of the first part of this huge undertaking is thus an event of some importance to palæontologists.

The author, Dr. W. Wenz, is well known as an authority on the Cainozoic non-marine Gastropoda and the compiler of the very substantial section of the "Fossilium Catalogus" which deals with this group. Even for such an indefatigable worker, the preparation within a few years of a treatise defining and classifying every recognized genus and subgenus of the Gastropoda, from the Cambrian faunas to those of the present day, must have been no mean task. It is true that M. Cossmann's "Essais de Paléoconchologie Comparée" (1895–1925), not quite completed owing to its author's premature death, has to some extent paved the way for this work by assembling an enormous quantity of data concerning the range and distribution of the various groups and by giving good descriptions and figures of genotypes. So far as the Palæozoic genera (with which the present part mainly deals) are concerned, however, Dr. Wenz does not appear to have been much influenced by the ideas on classification advanced by his predecessor.

The general scheme of classification adopted is that given in J. Thiele's "Handbuch der systematischen Weichtierkunde" (1929–1935), which is likely to remain the standard work of reference on the Recent Mollusca for some time to come. Except for a series of introductory chapters, which include a useful review of modern ideas on gastropod phylogeny, the present part deals entirely with the Archæogastropoda, the first of the three orders into which the subclass Prosobranchia is divided. Much of the detailed classification proposed is certainly new; a great part, no doubt, is merely tentative in view of the dissimilarity of many of the groups dealt with to Recent forms of known anatomical characters. It would have been preferable if the author had indicated which families are erected for the first time.

In matters of nomenclature this work appears to conform strictly with the International Rules, and no attempt has been made to perpetuate obsolete names by the arbitrary selection of *nomina conservanda*. The wise decision has been made to dispense with the 'section' as a taxonomic group subsidiary to the subgenus. Well printed text-illustrations, almost entirely copied from pre-existing works, illustrate the most important genera.

The Genus Youngia

By Ernest B. Babcock and G. Ledyard Stebbins, Jr. (Publication 484.) Pp. iii+106+5 plates. (Washington, D.C.: Carnegie Institution of Washington, 1937.) n.p.

THE genus *Youngia* was described more than a century ago by Cassini, but the characters on which the genus was based did not preclude the inclusion within it of species of several allied genera of the *Cichoriea*, and Cassini's species have long been merged in the genus *Crepis*. During his long study of the taxonomy and genetics of the latter genus, Prof. Babcock has repeatedly come in contact with certain Asiatic species invariably included in the genus *Crepis* which appeared generically distinct. For the reception of these species, the genus *Youngia* has been re-established and redefined.

Twenty-seven species, six of which are newly described, are included in the re-established genus, which is divided into six sections. The species mainly inhabit China, with extensions westwards to Ceylon, Kashmir and the Pamir-Altai cordillera and eastwards to Formosa and Japan. The monographic treatment includes discussions of the interrelationships of the sections and of the species within the sections, whilst admirably clear illustrations are given of all the species and subspecies. Two of the more widely distributed and polymorphic species which have been studied genetically show that variability is associated with polyploidy and parthenogenesis probably resulting from hybridization. This has led the authors to refrain from naming lesser variant forms, which are merely listed by number after the appropriate species. The major subspecific entities receive names but their citation as trinomials is to be regretted. The comparative scarcity of herbarium material consequent upon the remoteness of the localities at which many species occur will certainly lead to future additions to, and perhaps modifications of, the authors' arrangement; yet the work will remain of lasting value in having for the first time brought together and clarified the relationships of a group of species the previous systematic treatment of which has been unsatisfactory. W. A. S.

Modern Methods of Refining Lubricating Oils

By Vladimir A. Kalichevsky. (American Chemical Society Monograph Series.) Pp. 235. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1938.) 30*s*. net.

IN the United States, the older cruder methods of refining are fast becoming obsolete and are being everywhere replaced by solvent processes, which have the great merit of removing the unsatisfactory asphaltic constituents generally termed naphthenics. In addition, the systematic use of additives for improving certain particular characteristics is beginning to become of commercial importance. The time is ripe for the description and discussion of these new methods of refining and the general principles which underlie them: it is now provided in handy book form by Mr. V. A. Kalichevsky, as one of the well-known American Chemical Society series of monographs.

The solvent refining processes represent a great advance in chemical engineering and are characterized indeed by considerable daring as, for example, in the use of liquid propane as a solvent. They are continuous and even involve the use of two solvents which carry the separated constituents of the crude oil in opposite directions.

Besides removing the asphaltic constituents, a second separate solvent treatment is used to remove the high melting waxes, so that the final products are straw-coloured fluid oils which do not thicken even at the low temperatures experienced in high flying.

The book tells the full story in a practical manner and should be welcomed by a large number of those engaged in the lubricating industry. E. F. A.

The Children's Play Centre: its Psychological Value and its Place in the Training of Teachers

By D. E. M. Gardner. (Contributions to Modern Education.) Pp. xv+143. (London: Methuen and Co., Ltd., 1937.) 3*s*. 6*d*. net.

WE refer to this book, not so much because of its detailed account of the working of a play centre, a subject which is somewhat outside our province, as because we think it exemplifies a really scientific approach to the problems of child-study. As Dr. Susan Isaacs points out in her foreword, young teachers find it difficult to connect the generalizations of their text-books of psychology with their own experience, or with the actual children they have to face in the schools. In fact, they begin at the wrong end. They are led to disobey the accepted rules of pedagogic and of scientific method. From this mistake the play centre, where children can be observed under the most natural conditions, provides a way of escape. Let the young teacher begin there, and the text-books will convey far more meaning than they usually do at present.

The Observer's Book of British Wild Animals

Compiled by W. J. Stokoe. Pp. 224. (London: Frederick Warne and Co., Ltd., 1938.) 2*s*. 6*d*. net.

THIS is the fifth of a series of handy pocket books (see also NATURE, 141, 351; 1938), one of their merits being that they actually are pocket books, 5½ in. by 3½ in., and therefore convenient to carry on nature rambles. In this volume, sixty-nine species of British animals are described, and the text is illustrated by seventy-two illustrations, forty-six of which are in colour. Naturally, most of the book is devoted to mammals, but the few British reptiles and amphibians are also described. The term 'animals' in the title is used in the common, but erroneous, sense. However, so far, birds and butterflies have been dealt with in previous volumes. Thus, the present volume concludes in this series consideration of all terrestrial vertebrates. To those interested in the natural history of the countryside, this "Observer's Pocket Series" can be strongly recommended.

Cultural Contacts of Science*

By Sir Richard Gregory, Bart., F.R.S.

IN the study of man and his activities, three types of cultural development may be recognized; and they are all measured by different standards. In the Fine Arts the imaginative qualities of the mind appeal primarily to the emotions through stimulation of the æsthetic judgment; material culture is the province of mechanical arts; and science—the domain of reason—is systematic and formulated knowledge in all fields of human understanding—natural, moral, social and political. Natural science, or natural philosophy, is only one division of science as thus defined. The history of civilization is a history of intellectual development in which science has been the chief factor in changing habits of thought from superficial observation and speculative and anthropomorphic theories of causation to clear concepts, rational conclusions and progressive principles in the advancement of man and society.

In the most primitive times, man had to acquire knowledge of the world of Nature around him in order to survive. The effort to secure the food and shelter necessary for his existence demanded a never-ceasing exploitation of the resources of his environment for the progressive improvement of his material equipment—an equipment which he learned to turn against his fellow-man, no less than against the animal world upon which he preyed for food and clothing, or against which he must defend himself. But in this struggle, even more than on his personal prowess, his skill, and his knowledge of the habits of food-plant and animal, man relied upon his imagined understanding of, and his supposed power to control, the hidden causes of the nature and behaviour of the beings and objects of his world—in other words, his will to survive was rooted in magic. Though the magical beliefs of primitive man may seem to us vain and crude, let us not despise them; for in these blind gropings to probe causation in Nature, we may see the remote and humble beginnings of the urge to the understanding of the universe, which is science.

It is not, however, with man's progress in relation to material development with which we are now concerned, but with the contacts of science with what is known as 'polite' learning—literature, religion, and other expressions of the human spirit. The noblest aims of man are not represented by great industrial advances, but by the search for the truths upon which they are based, and by the influence of this effort upon personal and social ethics. These intellectual or spiritual associations of science were more common in former times than now, when we are passing through, or perhaps, as it may be, just emerging from, a materialistic age in which they tend generally to be neglected.

The Fine Arts and literature are usually confined to the expression of what are understood to be the eternal verities of life; and, so long as this is so, though their form of expression may change, a supreme standard of excellence may be reached in any epoch. In the fourth and fifth centuries before the Christian era, the works produced by the artistic and literary genius of the Greeks are masterpieces which will command admiration for all time; and ancient Rome, India and China have each had a golden age of artistic and literary achievement. Similarly in western Europe, architecture, painting and poetry have reached the highest level of excellence at various epochs and then suffered a decline. Apart from the development of technical excellence, progress in any of these arts of expression can only be in the elaboration and enrichment of creative ideas; but the store of these is not thereby increased, and each age—each type of civilization—must work out its own ideals. Artists may aspire to emulate the paintings of Raphael or Leonardo da Vinci, but they cannot use the works themselves as a background upon which to add their own conceptions.

Science, however, differs from the Fine Arts in the fact that every discovery extends the boundaries of knowledge and may be the starting-point of further progress. It was upon the foundations laid by Kepler and Galileo that Newton was able to construct the universal law of gravitation; and it is by the succession of such discoveries that science advances, while the picture it presents is continually being enlarged and having new details added to it. The time may come when art and literature will be moved by such achievements of the human mind to make manifest their real meaning, and the imagination will be so quickened by the spirit of man reaching out to the stars that artistic and literary response to the beauty and mystery of Nature will be deeper than ever before.

Associations of science with literature in former times are chiefly connected with astronomy—the

* Outline of the Elihu Root Lecture delivered at the Carnegie Institution of Washington on December 8 and to be published by the Institution in book form.

oldest of the sciences and the one most closely united with spiritual feeling. At the beginning of the history of civilization, the sun and moon were given divine attributes as well as used to mark the times of operations of life in days, months and years. Five thousand years ago, the Babylonians and Egyptians possessed a considerable store of knowledge of the skies. The constructions of the great temples and pyramids of Egypt, as described in preserved records, and shown in existing remains, are of particular astronomical interest, as well as for the study of mythology and religious belief. One of the most impressive structures of this kind, the remains of which still exist, is the great temple of Amon-Ra at Karnak, near Luxor, the length of which is about five hundred yards, with the open end pointing in the direction of the setting sun at the summer solstice. The rising of the star Sirius—the brightest in the heavens—just before the sun in July of each year heralds the annual inundation of the Nile and was used by early Egyptians to mark the beginning of a new year.

Observations of groups of stars seen just above the sun at dawn or at twilight were associated with seasons and other events on the earth in very early times. The groups were figures on a celestial dial, and the sun took a year to pass round the complete circle of the heavens upon which they were fixed. The division of the circuit into twelve parts, or signs, made up the Zodiac, as recognized and used for religious and seasonal observances by the Chaldeans, the Chinese, the Egyptians, Hindus, Persians, Greeks, Romans, and other peoples. The twelve signs or constellations of the Zodiac seem to be referred to in Joseph's second dream, and in Jacob's blessings of his children.

The sun as the source of all heat, light and life on the earth was the central object of religious belief of most early peoples. Whether it was worshipped as the god itself, or as his symbol, even by the priests, is doubtful; but for a short period in the history of Egypt, about thirteen hundred years before the Christian era, King Akhnaton, or Akh-en-Aten—signifying "The Blessed of the Disk"—the Sun-god was certainly worshipped as the one and only god, and the belief was, therefore, monotheistic. The finest expression in Egyptian literature is found in Akhnaton's "Hymn to the Sun-Disk". Similar hymns are found in the "Rig-veda", one of the four sacred books of the Hindu scriptures, where light is associated with moral and intellectual values, as well as with physicial properties.

Astronomy was thus studied by early peoples not only for practical purposes but also for religious observances. The gods or natural forces which determined the movements of celestial bodies were regarded as also ruling human nature. Astronomy and astrology were then combined in a single study. In the sixth century before the Christian era, Greek philosophers separated the conceptions of the influence of gods from the study of impersonal Nature, the laws of which were discoverable by the proper and methodical application of the human intellect. They first introduced the word φύσις, denoting *Nature*, to signify natural philosophy as apart from theology and mythology. The Hebrews also made a distinction between the worship of God and His works; but they saw all things as testimonies to the wisdom and power of the Almighty—as subjects of wonder and spiritual exaltation rather than as matters of intellectual inquiry.

There are many references to astronomical objects and phenomena in classical Greek literature from the sixth century B.C. onwards. The earliest Greek work on astronomy is that of Eudoxus, transmitted in verse by Aratus—third century B.C.—who mentions forty-four constellations. A commentary upon their works was written by Hipparchus, who was as great an astronomer as Aratus was a poet. Ptolemy (A.D. 100–178), who was the definitive authority on astronomy of the ancient world, enumerates forty-eight constellations; and these, with few changes, are still used by astronomers to mark the grouping of stars in the sky.

Aratus's astronomical poem was esteemed by both Christian and pagan philosophers. When the Apostle Paul spoke to men of Athens on Mars' Hill, he referred to Aratus when he remarked "as certain also of your poets have said: For we are also his offspring". The words used by St. Paul follow very closely passages in the text of the poem of Aratus. Cicero and other writers translated Aratus's poem into Latin; and several Roman poets, including Virgil, quoted largely from it. In his great didactic poem, the "Georgics", Virgil brings man into intimate contact with Nature by describing the relationship between agricultural operations and the constellations visible at different seasons. In the same period, Lucretius produced his great work "On the Nature of Things", which is more remarkable for its anticipation of modern views as to atoms and their relationship to space than for its description of scenes or actions in the celestial drama as viewed from the earth. His purpose was to present a theory or theories which would explain natural things and laws without assuming the existence of deities as legislators.

During the period from the ninth to the fourteenth century, when the study of natural knowledge was cultivated by the Arabs with con-

spicuous success, astronomy was given particular attention and Arabic works upon it, translated into Latin, were afterwards widely read. Omar Khayyam, who lived in the latter half of the eleventh century, was an astronomer as well as a poet, though there are few astronomical references in his "Rubaiyat". He lived in the golden age of Arabic science; and the next great poetic genius was Dante, who made detailed and accurate use of the scientific knowledge of the times. Dante derived his knowledge of celestial objects and movements from a celebrated Arabic astronomer, Alfraganus, who flourished at the beginning of the ninth century and wrote a number of works on the sundial, the astrolabe and other astronomical subjects. Chaucer was another astronomer-poet who was indebted to Arabian science for much of the astronomical knowledge revealed in his works. He was the first great master of English verse, and his poems contain many references to celestial subjects, chiefly from the point of view of their relationships to human life and events.

Three centuries after Dante, Milton, in "Paradise Lost", described many astronomical objects and phenomena. Milton met Galileo, and in well-known lines refers to the astronomer's observations of the moon and the Milky Way. He knew the Copernican system of the universe, which was established by Galileo's observations, and described the differences between it and the Ptolemaic system which was then generally accepted, but he left the question unanswered as to which system should be accepted as true. Even Francis Bacon persistently rejected the Copernican theory, though there were eminent men, astronomers and others, anterior to, or contemporary with him, who adopted and taught it. The theory had been before the world for nearly eighty years before Bacon's 'Novum Organum" was published, and he gave great attention to the methods by which astronomy ought to be studied; yet he refused to accept the theory and constructed an elaborate celestial system of his own. Even after the discovery of the satellites of Jupiter by Galileo in 1609, seventeen years before his death, Bacon opposed the Copernican view that the earth moved in an annual orbit around the sun. It is unfortunate that a philosopher with such a wide range of knowledge, whose object was to show others how science could be advanced, did not appreciate the simplicity of the Copernican theory as an explanation of celestial movements. In this respect, however, his attitude was that of many of his contemporaries, including those not influenced by theological prejudices, as well as Catholics and Protestants.

The adoption of the Copernican theory meant that the foundations of belief in the earth and man as centres of the universe were destroyed. Later, when Newton had shown that the law of gravitation was sufficient to account not only for the movements of the planets but also for the paths of comets, it was no longer reasonable to believe that these were sent as signs or warnings to the human race. The intellectual expansion thus brought about, together with the sense of justice which resulted from the existence and permanence of law in Nature, profoundly influenced human thought and resulted in social changes which had the greatest civilizing effects.

A similar revolutionary adjustment of thought had to be faced when, three centuries after Copernicus, man was placed in a new relationship to the rest of living creatures and shown to have a sub-human ancestry. The principle of evolution gives new hope to life and the promise of a golden age in the future instead of the past, if man follows his highest ideals; for, as T. H. Huxley pointed out, evolution embodies the idea of progressive social and ethical standards, as well as development of physical structure. Any nation or people which separates itself from the rest of the world in the name of race or religion, and cultivates ideals of conquest by force in order to assert its claims, is reverting to the law of the jungle and retarding the higher evolution of mankind.

The view that the sole function of science is the discovery and study of natural facts and principles without regard to the social implications of the knowledge gained, can no longer be maintained. It is being widely recognized that science cannot be divorced from ethics, or rightly absolve itself from the human responsibilities in the application of its discoveries to destructive purposes in war or economic disturbances in times of peace. Men of science can no longer stand aside from the social and political questions involved in the structure which has been built up from the materials provided by them, and which their discoveries may be used to destroy. It is their duty to assist in the establishment of a rational harmonious social order out of the welter of human conflict into which the world has been thrown through the prostitution of the rich gifts with which they have endowed the human race. Science has made the world one through the facilities of transport and communication now available; and it recognizes no political or racial boundaries in the fields of knowledge. By the wise use of this knowledge, the earth could indeed become a celestial dwelling-place instead of a world of dust and ashes which prevailing conditions seem to be making its destiny.

The Electron Microscope

By Prof. L. C. Martin, Imperial College, London

INTRODUCTORY

IT has been known for many years that cathode rays can be deflected by electric and magnetic fields, but in 1926 Busch showed that axially symmetrical fields would have the power of focusing such rays, much as light is focused by a lens.

Any axially symmetrical lens system will produce a fairly sharp optical image of objects near the axis, provided that the aperture is so far reduced that only rays travelling very close to the axis are allowed to pass through the system, and provided moreover that strictly monochromatic light is employed. This reduction of the aperture is essential in general to avoid the spherical aberration of the rays which make larger angles with the axis, and the consequent deterioration of the definition of the image; but on the other hand, the finite wave-length of light causes a spreading of each image point, such that the spread is inversely proportional to the aperture of the lens system. This tendency makes it impossible to retain very sharp images with optical lenses of smaller and smaller angular aperture, and highly complicated lens systems have to be used to allow of the attainment of large apertures without concurrent spherical aberration. Thus in the relatively simple case of the ultra-violet microscope objective (numerical aperture 1·2), five or six specially shaped lenses, mounted with the greatest care, have to be used; but the resolving limit cannot be brought much below about 0·15 μ without great difficulty. In other words, the closest approach of two object points compatible with the separation of their images is about one seven-thousandth part of a millimetre.

POSSIBILITIES OF THE ELECTRON MICROSCOPE

Until the origin of the electron microscope, it did not seem possible that this limit would ever be lowered very considerably, but once the possibility of forming images with electrons was realized, it became apparent that further progress was possible. The experiments of Prof. G. P. Thomson and others had shown that the wave-lengths of the 'waves' associated with medium-velocity electrons are only about a hundred-thousandth part of the wave-length of ultra-violet light, and therefore the relative aperture of an electron-optical system could be lowered drastically, in order to avoid spherical aberration, without incurring any considerable spreading of the elementary image points. Such 'lenses' have now been made which work at numerical apertures of much less than 0·1; but the residual spreading of the image is almost entirely due to other causes, that is, to 'chromatic aberration' (due to the presence of electrons with differing velocities), to spherical aberration, and to faulty centration together with the characteristic aberrations of extra-axial image points. The best of such images appear to have resolving limits of approximately 0·01 μ and will bear magnifications up to 20,000 or more without losing apparent sharpness.

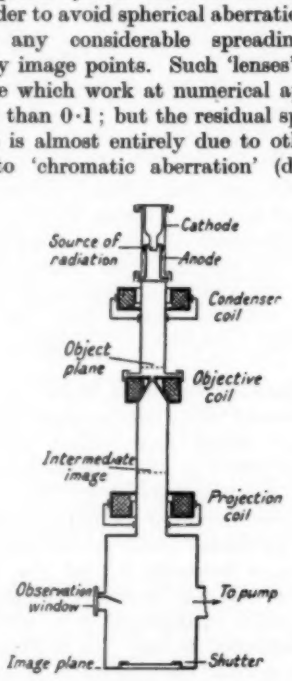


Fig. 1.

KNOLL AND RUSKA'S ELECTRON MICROSCOPE.

The pioneer work in building such instruments was due to Knoll and Ruska working in Berlin (1932). They employed a cold-cathode discharge tube as a source of electrons, which were projected through a very small aperture along the axis of a highly evacuated tube (Fig. 1). The electron beam passed in succession through ironclad coils representing the condenser, the objective, and the projection eyepiece of a microscope, and finally fell upon a fluorescent screen or photographic plate for the registration of the image. The first pictures obtained were 'silhouette' images of fibres, perforated metal foils, and the like. Then in Brussels,

Marton made early experiments on the electron-photography of biological tissues impregnated with osmium, and of bacteria mounted on very thin films of nitro-cellulose. In Great Britain an instrument was designed by the present writer and his colleagues in co-operation with Messrs. Metropolitan-Vickers Electrical Co., Ltd., by whom it was made (Fig. 2). It is intended to give special facilities in the microscopy of objects alternatively by light or the electron beam, and experiments with it have been in progress for the past two years. The resolving limit attained is already better than that of the ultra-violet microscope, and Prof. G. P. Thomson is directing a systematic investigation of various troubles preventing better definition. Hot-cathode discharges are now being employed by the German workers.

The results so far obtained on the Continent are wonderfully promising, although claims have been made in a few cases which do not appear to be justified by the photographs reproduced. Exceptionally striking pictures of colloidal structures, for example, threads of nickel carbonyl, and particles of colloidal gold in a film of lithium borate, have been published by Beischer and Krause, after which the resolution of *Amphipleura pellucida* in dots seems a pedestrian performance. In order to photograph bacteria, they are dried by a special process on an extremely thin film of collodion, and can be photographed without any other special treatment. Photographs have been published (notably by von Borries, E. Ruska, and H. Ruska) showing various organisms such as *Micrococcus flavus* under extraordinarily high magnification, such as 16,000; one picture exhibits a fine structure, whatever its nature or origin, on the film around the dried bacteria, which could not possibly be observed in optical pictures (Fig. 3).

Fig. 2.

ELECTRON MICROSCOPE AT THE IMPERIAL COLLEGE, LONDON.

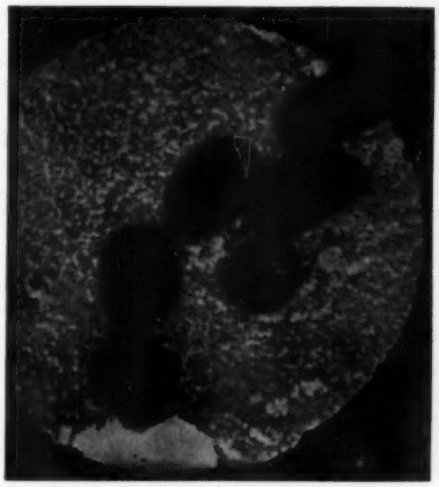


Fig. 3.

Micrococcus flavus; ELECTRON-OPTICAL MAGNIFICATION, 16,000. STRUCTURES NEAR THE COCCI DO NOT OCCUR IN THE SUPPORTING FILM; PHOTOGRAPHS OF PLAIN FILMS SHOW A COMPLETELY CLEAR GROUND. PHOTOGRAPH BY VON BORRIES, E. RUSKA AND H. RUSKA, REPRODUCED BY COURTESY OF HERR E. RUSKA, OF SIEMENS UND HALSKE A.G.

Delicate objects placed in an intense electron beam may of course suffer damage by heating and further by becoming so highly charged that electrostatic repulsive forces disintegrate the structure; it will therefore be understood that there is a great deal of special technique to be developed. The necessity of mounting the objects in a high vacuum is naturally a severe complication.

THERMIONIC EMISSION

The term 'electron microscope' has also been given to electron-optical systems designed to give images of surfaces which are self-emitters of electrons either by thermionic or by photo-electric action. Thus, for example, suitably activated

surfaces of iron and nickel vary greatly in emissivity according to their crystalline state, and the changes in structure with change of temperature can be followed in an interesting way by projecting the images of such surfaces with suitable magnetic or electrostatic lenses, although the magnifications employed are not usually greater than one hundred, and there is little question of high resolution. The present article will not attempt to deal with these systems.

PROBLEMS IN ELECTRON MICROSCOPY

Having briefly noticed the present state of progress in the subject, it may be of interest to indicate some of the problems which have to be faced in any attempt at further progress.

In an ordinary photomicrograph, a 'picture' of an opaque object is formed by absorption of the light, but when the object is only distinguished by a variation of refractive index with respect to the surrounding medium, the contrast in the image is secured, in many cases, because some of the light from particular regions of the object is deflected outside the aperture of the objective, and thus fails to reach the corresponding part of the image.

In the case of the electron radiation passing through a thin layer of matter, a large proportion of the moving electrons may not pass sufficiently close to any of the electrons or nuclei in the atoms of the film to suffer perceptible changes in energy or direction, since, as we now understand, the particles conceived as forming an atom occupy effectively but a small part of its dimensions as usually estimated. Other electrons may pass comparatively close to a relatively massive nucleus and swing around it in a hyperbolic orbit, suffering a comparatively large change of direction but, in comparatively many cases, inappreciable change of energy; such collisions would be said to be of the 'elastic' type.

As has been shown by Bohr, however, the effect of the electrons present in the atom cannot be neglected; they are not to be regarded, in this connexion, as fixed, and thus can take up more or less kinetic energy from the particle in quantum units. In some cases the moving electron interacts so violently that one or more electrons are completely removed from the atom; the loss of kinetic energy may then be comparatively great and accompanied by a large change in direction of the incident particle. The collision is of the 'inelastic' type. In some cases (fluorescence) the energy-levels of the electrons of the material may be altered and light is emitted as they return to the normal configurations. In very thin films of matter the electrons are not likely to encounter more than a single nucleus sufficiently closely for appreciable scattering, and the most probable angle of deflection is proportional to the square root of the thickness, but with increasing thickness or with the presence of heavier atoms at particular regions, the mean scattering angle may be increased, sometimes by successive encounters. Some electrons may be completely trapped by the film, and if it is a non-conductor they remain as a charge on the surface.

In preparing objects such as bacteria for the electron microscope, they are usually mounted on very thin films of nitro-cellulose, and it is fortunate that the amount of scattering and spread of velocity caused by the film does not seem to be so great as to introduce serious trouble with spherical and 'chromatic' aberration. Potentials of about 75 kv. have usually been employed for this work. If an object is mounted on a film, it will scatter the radiation to a greater extent than the film support, and, as widely scattered electrons will fail to enter the narrow aperture of the objective, the object will show up as a dark region in the image. We have to remember, however, that the velocity-spread caused by the mount may interfere to some degree with the definition, and the image will then differ to some degree from purely silhouette effects. Thus the probability of detecting an object or separating the images of two objects depends on the relative scattering power as distinct from the support, if any.

If it were possible to produce electron images free from spherical and 'chromatic' aberration, the only factor controlling the resolving limit would apparently be the wave-length of the de Broglie waves. Assuming the aperture of the corrected lens to be 0·1, a limit of less than 10^{-7} cm. might apparently be attained. Apart from the questions raised above there are, however, serious difficulties. It does not seem possible to secure 'achromatism' of the electron lenses, and the only alternative is to make the incident radiation as homogeneous in velocity as possible. Various factors require a voltage of 50,000 or more, and it is difficult to maintain a perfectly steady electrical pressure of this magnitude. The usual circuits employ a transformer with valves to produce half-wave or full-wave rectification, together with as large a reservoir condenser as possible. The residual ripple can be reduced to one tenth of one per cent without undue trouble, and may be further reduced by filters.

When cold-cathode discharges are used, the current can be stabilized by a saturated diode valve, and the inhomogeneity is reduced to that caused by collision effects, etc., in the discharge tube supplying the electron stream. In all cases the perfection of the vacuum technique is essential,

and conditions of the utmost constancy must be obtained. If necessary, complete stabilization of the supply for hot-cathode work can be attained by the use of a battery, but the high initial cost, maintenance, and rapid depreciation of such a battery present difficulties which will be well understood.

Assuming that the voltage spread can be sufficiently reduced, the question of the 'spherical' aberration of the 'lenses' comes into prominence. It is apparently not possible to design magnetic or electrostatic lenses which are free from this defect, and no known arrangement seems to do more than approach a certain minimum value. This question has been studied theoretically by Scherzer and also, on the basis of numerical calculations, by Rebsch, who reaches the conclusion that the limit of resolving power of electron-optical systems will always be set in this way at about ten to one hundred times the electron wave-length, instead of going below the wave-length itself as might be inferred from Abbe's optical formula. Whether or not this conclusion is just, the implied limitation does not exclude the possibility of opening up still further new fields in high-power microscopy.

Just as in ordinary optics, however, where more than half the serious troubles are due to faulty construction and lack of symmetry of the parts, the electron microscope is by no means easy to perfect in such respects. In the first place, the present instruments are given a length of about two metres in order to reach the required magnification in two stages, and moreover a complicated object-holder chamber and adjustable coils have to be included in the apparatus. It is thus scarcely practicable to secure a geometrical symmetry by merely screwing together a set of lathe-turned parts as is done in the telescope. Even if this were done, the electron beam would still be appreciably curved, unless the axis of symmetry coincided with the direction of the earth's magnetic field. Again, it is by no means easy to make an ironclad magnetic coil truly symmetrical, in the magnetic sense, about its mechanical axis. The residual irregularities in the winding, and probably especially the variation of magnetic resistance in the gaps of the soft iron sheathing, produce a lack of symmetry in the field; even more troublesome is the fact that the asymmetry varies with the varying current, especially when the magnetism of the sheath is approaching saturation. The perfection of such coils is an interesting problem.

For a number of reasons, therefore, the early instruments were built up with components arranged as symmetrically as possible, and the beam was sometimes persuaded along its required path by judicious use of bar magnets! In the instrument described by Martin, Whelpton, and Parnum, the necessary control was obtained in a less objectionable way by the use of paired coils in the Helmholtz manner. This instrument, in use at the Imperial College, is now so arranged that the objective coil can be adjusted both in tilt and lateral position, and further, the condenser and projection coils can be adjusted laterally, all from outside the vacuum.

Neglecting the residual asymmetry of a coil which is not, after all, very large, the system of initial adjustment depends on the fact that if any 'object' is not on the axis of a coil, the image will move in a radial direction around the axis when the current in the coil is varied. The finer centring adjustments may require the deliberate use of inhomogeneity in the beam velocities. Failing perfect centration, very serious aberrations in the image will correspond to lateral chromatic spreading of the image points and 'coma', even in the centre of the picture.

A major part of the experimental work at the Imperial College has been devoted to a study of the 'optical' adjustments of the system in the above sense, and it is hoped that when more perfect electrical equipment is available, the experience thus gained will make it possible to obtain the optimum results.

A word may be added as to the relations of the electron microscope to the research methods of 'X-ray' and 'electron diffraction' analysis. It is true that where some degree of regularity exists in the structure of matter, these powerful and beautiful methods can be used with confidence to elucidate the atomic pattern, just as diffraction spectra appearing in the optical microscope may prove the existence of a structure which still cannot be resolved by the instrument. It is the possibility that the electron microscope may prove a means of examining irregularities and discontinuities in structures which makes it seem so promising, even if the method cannot deal with elements so small as those of crystal lattices.

On the analogy of the Abbe principle, it may be said that if the aperture and corrections of the 'lenses' could be so far improved as to include the electron diffraction maxima from a crystalline structure without incurring appreciable aberration, the very elements of the lattice would be resolved in the picture. That achievement may at present be quite outside the limits of apparent probability, but the subject is still in its infancy and at a stage corresponding to the period in the history of the optical microscope before the achromatic lens was invented. We may learn from the experience of those days not to be over-confident in setting limitations to what is possible.

Obituary Notices

Sir Thomas Callender

SIR THOMAS OCTAVIUS CALLENDER, who died at his home at Bidborough Court, Kent, on December 2, at the age of eighty-two years, spent a long and very busy life in promoting the electrical industry. He was the eldest son of the late W. O. Callender of Bournemouth and was born in Glasgow in April 1855. He was educated at Greenock, in London and later at Boulogne-sur-Mer. The outbreak of the Franco-Prussian War made it necessary for him to leave France, and later he entered his father's office in London, devoting himself to the asphalt, paving and bitumen refining business of which W. O. Callender was founder. Having acquired an interest in part of the Trinidad Lake, W. O. Callender and two of his sons founded the business of Callender and Sons, in 1877, for the supply of Trinidad bitumen. Large quantities of bitumen were refined and used for road-making and building purposes, but it was felt that further developments were possible, and its uses for electrical work were constantly considered.

When Callenders started carrying out complete contracts for both the making and laying of underground mains, their practical knowledge of road-making proved of great value. In the early days, the only output for insulated wires was in connexion with the electric telegraph. When Edison and Swan brought into practical use the electric glow-lamp, it became clear that some materials, such as Callenders were making, could be usefully employed for the heavy mains which would evidently be required. Bitumen in its natural state was useless, as it is easily affected by heat and consequently unstable. After many experiments, it was discovered that a combination of certain palm oil residues with bitumen produced a material that could be vulcanized and so could be employed as a covering for both heavy electric cables and light electric telegraph wires. For this experimental work, Letters Patent (No. 4409) were granted to Mr. W. O. Callender in October 1881. Mr. Tom Callender was elected manager of Callender's Bitumen Telegraph and Waterproof Company formed to develop this discovery. Sir Samuel Canning (who with Lord Kelvin was famous for his Atlantic cable experience) was appointed consulting engineer to the company.

In 1894 the directors were able to report that out of eighty-two electric light stations then in existence or under construction in Great Britain, their Company had supplied mains to thirty-eight. In July 1896, Callender's Cable and Construction Co. was formed and took over the entire interests and contracts of the old company: Mr. Tom Callender was appointed managing director and controlled the business with conspicuous success almost up to the day of his death.

Tom Callender was a great traveller. Shortly after he joined his father's paving and bitumen business, he spent nearly a year in Rumania repaving the entire city of Jassy. His journey to St. Petersburg in 1880 concentrated his interest in electrical work. The illumination produced by an immense number of Jablochkoff candles at the Opera House astounded him. Three years later Callenders installed the necessary underground mains when Covent Garden Opera House, London, was electrically illuminated. On a later occasion he went to the United States by the Cunard S.S. *Scythia*, which was lighted by paraffin lamps, and returned by the Cunard S.S. *Servia*, the first large liner to be equipped with an effective electrical installation. He was so impressed that on his return he urged his company to devote all possible attention to electrical development. In 1930, Callenders acquired a new research laboratory in which is installed the most modern electro-technical apparatus. It is mainly employed in performing experiments with the object of elucidating the trend of future evolution in the cable industry. In opening it, Lord Rutherford made a very appreciative speech on the work it was doing under the superintendence of Mr. P. V. Hunter.

Tom Callender married in 1885 Bessie, the eldest daughter of Mr. William Pinnock, of Belvedere, Kent, and had one son, Mr. T. O. Callender, who has been a director of the present company since 1932. The controlling genius of the extensive Callender interests was honoured by knighthood in June 1918. This well-deserved recognition gave the greatest pleasure both to the numerous friends of Sir Thomas and Lady Callender and also to the company's large staff in all parts of the world. The company published a memorial volume "The Story of Callender's, 1882–1932" to celebrate its fiftieth anniversary. It gives biographical sketches of all the distinguished members of the staff and also an account, with photographs, of the works the company has done and is doing in almost every part of the world. Among them are Windsor Castle (1907), Keble College, Oxford (1909), Birmingham (1890), Bombay (1908), Agra (1924), Hong Kong (1904), the City and South London Railway (1889) and Banhida, Hungary (1928).

A. R.

Prof. J. W. Bews

J. W. BEWS was born at Kirkwall, in the Orkney Islands, in 1884, being the younger son of the late James Bews, of Berry Hill, Scapa, Orkney. From the Kirkwall Burgh School he entered the University of Edinburgh as Earl of Zetland bursar in 1902. After graduating, he was appointed lecturer in economic botany in the University of Manchester, but returned to Edinburgh in 1908 as lecturer in plant physiology and assistant professor of botany.

In 1910, Bews was appointed professor of botany in the Natal University College, with which he has since been associated except for the period 1925–27, when he occupied the chair of botany at Armstrong College, University of Durham.

As soon as Prof. Bews arrived in Natal he began his investigations of the vegetation, and within a short period had published a number of important papers on the plant ecology of Natal and of South Africa. He was a pioneer of plant ecology in South Africa, and in addition to making many important contributions to the science of ecology, his work has had an important bearing on many economic questions, such as soil erosion, veld burning, over-grazing, afforestation and weed control. In particular, his work on the grasses and grasslands of South Africa has stimulated much research which is now being carried out in various parts of the country, and is producing many important changes in some aspects of agricultural practice.

In 1921, Bews completed a "Flora of Natal and Zululand", and later investigated the origin, evolution and migrations of the South African flora. After publishing several papers on this subject he issued his conclusions in a more extended form in a book on "Plant Forms" in 1925. This led naturally to a wider study of the classification and evolution of plant growth forms, and the results were summarized in another book on "The Ecological Evolution of Angiosperms".

During his short, but successful, stay at Armstrong College, Newcastle-upon-Tyne, Prof. Bews worked assiduously at the grasses, with the result that in 1929 his "World's Grasses" was published. This important work is accepted as standard throughout the British Empire and the United States.

In 1930, Prof. Bews was appointed first principal of the Natal University College, and has been responsible for organizing and guiding the recent rapid developments which university work in Natal has undergone, and for laying the foundations of the future University of Natal. During this period, in spite of heavy administrative responsibilities, he found time to apply himself to a study of man and some of the problems confronting mankind. He approached these also from the ecological point of view, and wrote two books on the subject—"Human Ecology", published in 1935, and "Life as a Whole" in 1937. His synthetic approach to these problems was along new lines, and he considered these books merely as a preliminary survey of the field. In addition to his scientific research work, which is contained in numerous published papers, as well as in his books, Prof. Bews built up a strong department of botany at the Natal University College, and achieved much success both as a teacher and as a director of student research.

Prof. Bews occupied an important and prominent place in the administration of university and scientific affairs in South Africa. He was a member of the Council of the University of the Cape of Good Hope, and of the University of South Africa, several times chairman of Senate of the University of South Africa, and a fellow of the Royal Society of South Africa. In 1931, he was president of the South African Association for the Advancement of Science, and in 1932 was the recipient of the South African Medal, which is the Association's premier award. In 1932 he was also one of a small deputation of eminent men of science chosen to represent South Africa at the centenary meeting of the British Association.

Great as Prof. Bews was as a scientist and administrator, he was equally successful in attracting a circle of appreciative friends both in South Africa and at home. He was only two years with us in Newcastle, yet those of us who were fortunate enough to gain his friendship will never forget it or the genial placidity with which he confidently faced all difficulties.

We all feel the better for having enjoyed the privilege of knowing him.

J. W. HESLOP HARRISON.

Mr. J. J. Kneen

WE regret to record the death of Mr. J. J. Kneen, distinguished as an authority on the antiquities and language of the Isle of Man, which took place on November 21, at the age of sixty-six years.

John Joseph Kneen was born on September 12, 1872, and educated at St. George's School, Douglas, Isle of Man. His lifelong devotion to Manx studies received recognition not only within the island, but also from outside. He was past-president and secretary of the Manx Society, which exists for the preservation of the language, literature and music of the Isle of Man, and a member of the executive of the World Manx Association for the federation of Manx people throughout the world, as well as of the Manx National Assembly. In 1930–31 he was president of the Manx Natural History and Antiquarian Society. The University of Liverpool conferred upon him the honorary degree of M.A. in 1929; and four years later he was made 'Ridder' of the First Class of the Order of St. Olaf of Norway. His most signal distinction, however, was a grant of £200 from the trustees of the Fridtjof Nansen Fund to the trustees of the Manx Museum and Ancient Monuments for the purpose of enabling him to continue his researches on Manx place-names, and more especially of recording the true local pronunciation of these names before precise knowledge of the Manx tongue had died away.

WE regret to announce the following deaths:

André Blondel, since 1913 a free member of the Paris Academy of Sciences and a distinguished electrical engineer, known for his work on alternating current theory and for the development of the oscillograph and of the radio beacon, on November 15, aged seventy-five years.

The Right Hon. Lord Chalmers, Governor of Ceylon from 1913 until 1916, a trustee of the British Museum during 1924–31, and president of the Asiatic Society during 1922–25, on November 18, aged eighty years.

Dr. F. W. Goodbody, lecturer in medical chemistry in University College, London, on November 30, aged sixty-eight years.

Sir Brajendranath Seal, formerly vice-chancellor of the University of Mysore, known for his work in education and Bengali philosophy, on December 3, aged seventy-four years.

News and Views

Pilgrim Trust Lecture

THE first Pilgrim Trust Lecture was delivered on December 8 before the Royal Society, meeting in the historic lecture theatre of the Royal Institution, by Dr. Irving Langmuir, of the Research Laboratories of the General Electric Company, Schenectady, N.Y. A brief account of the substance of the lecture appears on p. 1085. It will be recalled that the announcement of the institution of this lecture was made by Sir William Bragg in his presidential address last year to the Royal Society. The scheme for the lectures was drawn up by the Royal Society and the U.S. National Academy of Sciences, and the Pilgrim Trust very generously agreed to provide an honorarium of 250 guineas a year for six years. The lectures are to be delivered in alternate years in London and Washington by an American and a British man of science respectively. Sir William Bragg suggested, when referring to the lectures, that they might be used to transmit new ideas which have begun to bear useful fruit and give promise of wide expansion, rather than to record past achievements, and Dr. Langmuir's choice of subject and his method of handling it must have been gratifying to Sir William. Dr. Langmuir himself must be congratulated on giving a most inspiring lecture on a difficult subject, and on the fact that he had the courage to begin with the very elementary facts. Thus the first link in another chain binding together the peoples of Great Britain and the United States has been well forged, and it should not be impossible to find means to make the lecture a permanent institution. Such international contacts are of vital importance in these days of strife and world unrest, and every effort should be made to promote active co-operation between the scientific workers of different countries. It is much to be hoped that the approach made by Dr. Bosch, president of the Kaiser Wilhelm Gesellschaft, to the Royal Society, which was referred to by Sir William Bragg in his presidential address on November 30 last, may be the beginning of yet another of these international bonds.

Prof. J. W. Cobb, C.B.E.

PROF. J. W. COBB retired recently from the Livesey professorship of coal gas and fuel industries in the University of Leeds—a chair which he had held since 1912, shortly after its foundation, when it was the only university chair in fuel technology in Great Britain. In response to a circular of appeal, a sum of about £850 has been contributed to signalize his services to the University and to industry, notably the British gas industry. Of this sum £583 was contributed through the Institution of Gas Engineers. On December 9, at the University of Leeds, with Major G. H. Kitson in the chair, certain presentations were made and the balance—£750—was presented to the University of Leeds. In accordance with the wishes of Prof. Cobb, it is proposed that the income from it be used to assist students of the Department of Coal Gas and Fuel Industries with Metallurgy to meet the cost of maintenance while at the University or to cover other expenditure necessary for their studies or researches. Mr. R. Robertson, president of the Institution of Gas Engineers, said Prof. Cobb is held in the highest esteem by everyone in the gas industry. He is already an honorary member of the Institution of Gas Engineers, but from now on he can regard himself as an honorary member of the gas industry at large. Mr. H. J. Hodsman, speaking for the Department, said that nowadays fuel research is a comparatively fashionable branch of science; but when Prof. Cobb arrived in 1912 the Department was the only one of its kind in the country and it had very few students. Its present position was therefore a measure of Prof. Cobb's achievements. Prof. J. H. Priestley and the Vice-Chancellor also added their praises of Prof. Cobb and his work for the University.

Wladimir Markownikoff (1838–1904)

ON December 22 occurs the centenary of the birth of the Russian chemist Wladimir Markownikoff, whose investigations in the latter part of last century were of great importance to the petroleum industry. He was born in the neighbourhood of Nijni-Novgorod and was a student at the University of Kasan, where he came into contact with Alexander Mikhaïlovitch Butlerow (1828–1886), whom he succeeded in 1869 when the latter had been transferred to the chair of chemistry in the University of St. Petersburg. Meanwhile, Markownikoff had been sent to Germany, where he worked under Kopp, Baeyer and Kolbe. After his return to Kasan he published his memoir "Ueber die reciproke Beeinflussung der Atomie im Molecule". In 1871, with five colleagues, he resigned his post for political reasons, but received an invitation to the chair of chemistry at Odessa, whence he was transferred to Moscow in 1873. Here he began his long and arduous investigations of Caucasian petroleum. In 1893, without any reason being assigned, he was deprived of his chair, his emoluments, and his official residence, but nevertheless he continued to carry on his researches in his own house, assisted by his faithful servant Mikhailo. He died suddenly on February 11, 1904. He wrote some sixty memoirs relating to petroleum, army disinfection practice, the plague and the chemical industry in Russia. In 1898 he was elected a foreign member of the Chemical Society, in the *Proceedings* of which E. J. Mills wrote of him as a conscientious man of science of unremitting industry, and in political affairs an outspoken patriot.

Queen Mary College

QUEEN MARY COLLEGE celebrated this week the anniversary of the presentation of a Royal Charter to the College by Her Majesty Queen Mary, the Patron of the College, on December 12, 1934. The proceedings culminated in a reception on the evening of December 16, when the principal of the College, Prof. G. M. Bennett, Prof. J. T. MacGregor-Morris, Miss Florence Rich, and Sir John Russell are being admitted as fellows of the College. The College, which owes so much to the insight and wise guidance of its late principal, Mr. J. L. S. Hatton, and its present principal, Sir Frederick Maurice, occupies a unique position in the scheme of the University of London. Situated a mile and a half east of Aldgate Pump, it provides a university course of training for students drawn in the main from the population of Essex and Middlesex, but not from these regions only, for within its walls are to be found students coming from all parts of Great Britain and of the Empire.

QUEEN MARY COLLEGE, which has grown steadily from a small beginning as the Technical School of the People's Palace, has for some time past realized the urgent need for the extension of the housing of its Faculties of Art, Science and Engineering and for the provision of hostels and athletic grounds for its students. It has courageously embarked on a building scheme, under which the Engineering Departments, the Chemistry Department, the Aeronautical Department, and the Botany, Geology and Geography Departments have been extended or reconstructed; new Zoology and Arts Departments have been built, and a high-voltage laboratory, the first of its kind in London, has been equipped. The cost of this completed portion of the programme is some £118,000, of which £113,000 has been received or promised. A great deal, however, remains to be accomplished, and the College is now considering the building of a college hall, dining hall and kitchens, the reconstruction of the Students' Union rooms, the rehousing of the administrative offices and an urgently needed extension of the Physics Department. The cost of this last part of the building scheme is estimated at £125,000, and all interested in college and university life in London will wish the Governors of Queen Mary College an early success in their attempt to provide a college which shall, in its material equipment, be worthy of the traditions which it has established in its thirty-one years of life as a School of the University of London.

Birkbeck College

BIRKBECK COLLEGE, University of London, celebrated on December 7 its 115th anniversary with an eloquent oration on "Ends and Means" by Sir Richard Livingstone, president of Corpus Christi College, Oxford. The Foundation oration dealt with the underlying principles of morality in individual and social intercourse in contrast with the present unrest in world affairs. In his report, which was followed by the presentation of graduates, Dr. George Senter, principal of the College, mentioned various details about its progress, the plan for moving it to the Bloomsbury site, the distinctions gained by the staff, and the activities of the various College societies. During the last academic year, there were 971 students registered, 122 having graduated. Statistics show that 430 students were teachers, 176 clerks and 132 chemists. Considerable progress was made during the year with the plans for new College buildings on the Bloomsbury site. Towards the end of the session, instructions were given for the clearance of the site, and it was expected that the detailed plans would be submitted soon to the Governors. A notable appointment to the academic staff was that of Prof. J. D. Bernal who succeeded Prof. P. M. S. Blackett in the chair of physics. Prof. Bernal's work is mainly concerned with structural investigations by means of X-rays, and is of great interest to chemists and biologists as well as to physicists.

German Native Policy and Racial Theory

DISCUSSION of German colonial claims will be clarified by a statement of the policy which would be applied in native administration under racial doctrine, appearing in an official publication of the National Socialist Party—"The Colonial Question and Racial Thought" by Dr. Günther Hecht, an expert of the party on racial problems. As might be anticipated, the principle of segregation, it would appear from a summary of the provisions by the Berlin correspondent of *The Times* in the issue of December 12, is to be applied stringently, and any attempt to Europeanize or divorce the native from his culture is abrogated: he will neither be baptized, nor will his equality with Europeans be preached. No native will be allowed to leave the German colonies for Europe as either servant, worker, soldier or student, but on the other hand, coloured people will be allowed their full rights of existence in their own homeland, and no more will be demanded from them than they can achieve. No native will be allowed to become a German citizen, but they will nevertheless possess more rights than have been merely promised to them in other colonies. No European matter will be taught in native schools, lest Europe should be presented to them as the peak of cultural development and they should lose faith in their own powers. Local culture, therefore, will be fostered, but side by side with it there will be an introduction to an understanding of European civilization. In principle, higher schools and universities will be closed to natives. Without entering into extended comment on the principles of this policy, beyond noting a commendable adherence to the development of the native through his own culture, it may be questioned what opportunities will be afforded for development towards that self-determination, however remote it may be and whatever its form, which has been formulated as the end of native administration under mandatory policy.

Systematics in General Biology

THE annual general meeting of the Association for the Study of Systematics in General Biology was held in the rooms of the Linnean Society, Burlington

House, Piccadilly, London, on December 15. The inaugural meeting of this newly established association was referred to in NATURE of July 24, 1937, p. 163. At its inception, 53 biologists joined the Association, and since then the membership has increased to 162. The aims of the Association, among others, are: to study the bases and practical aims of taxonomy; to examine criteria employed in defining species and other systematic categories; to consider any modification of existing classification in the light of cytogenetic, ecological, physiological, embryological, biochemical and palæontological data; to press for increased attention to taxonomy in museums and other institutions; to organize research; to aid the production of handbooks on British animals and plants, and eventually to produce a British Fauna and Flora on uniform biological lines; to investigate methods of teaching systematics; to promote co-operation between workers in different branches of biology on problems of taxonomic interest. The Taxonomic Principles Committee has already considered several important problems, and has decided to prepare an index of all terms which have been used to designate groups below the rank of species. This should prove of value, especially to young research workers in taxonomy. The Committee on Comparative Systematics has examined the sources from which data for research on variability and other problems may be drawn. The Research Committee has initiated or assisted in the launching of twelve lines of research, and a list of institutions where such work may be done has been prepared. Work has been started on a book on the anatomy of Dicotyledons. The Committee on Handbooks is now compiling a review of existing taxonomic literature on the British flora and fauna. The provision of a check list of the British flora and fauna is being dealt with in collaboration with the Association of British Zoologists. Cheap systematic handbooks are also being considered.

THE Committee for Co-ordinating the Work of Natural History Societies has been aided in its exacting task by the British Association. The pioneer work of these various committees is commendable, and all biologists, whether directly interested in systematics or not, will be grateful for the results of their work. Various publications, such as articles in NATURE and *Chronica Botanica*, have been sponsored by the Association, and others are projected. Discussions and symposia on taxonomic subjects have been supported by the Association at meetings of the British Association and of the Linnean, Zoological and Genetical Societies. The Association has no constitution yet, but it has since worked with enthusiasm. It is considered that with a minimum membership of five hundred, each member paying the modest sum of £1 for life-membership, the Association could achieve all its aims. We hope that this enrolment will be achieved and even exceeded, for the Association has, in a very short time, showed that it is providing an essential service to biology, and considering its present projects, its usefulness will certainly continue to increase. Not only specialized systematists but also all other biologists would prove useful to this Association, which clearly deserves all the support it can get. Information concerning the Association can be obtained from either Mr. J. S. L. Gilmour, Royal Botanic Gardens, Kew, Surrey, or Mr. H. W. Parker, British Museum (Natural History), South Kensington, London, S.W.7.

Palæolithic Finds in Bulgaria

DR. DOROTHY GARROD'S account of her recent excavation of the cave of Batcho Kiro, near Drevono, in Bulgaria, given before the Society of Antiquaries of London on December 8, adds a link of no little importance to the chain of evidence of the distribution of cultures of the later periods of the palæolithic age in eastern Europe and adjacent regions. Dr. Garrod's excavations were carried out in the summer of 1938, when she had the assistance of Mr. James Gaul and Mr. Bruce Howe of Harvard University, by permission of the Bulgarian Government and with the co-operation of the National Museum of Sophia. The cave is very large with an intricate system of corridors running at least a kilometre into the rock. Flint implements had already been discovered here in association with bones of the cave bear by a local engineer. The present excavations were confined in the main to the principal chamber; and here for the first time in Bulgaria a stratified sequence of palæolithic deposits has been found. At the bottom of the section was a Mousterian level, in which the implements were made chiefly from pebbles of volcanic rock from a stream near by. Above this level were layers of deposits belonging to the Upper Palæolithic, in which the industries were more or less of Aurignacian type, and the implements were made of flint. They were associated with animal bones, among which were cave bear, cave hyena, and in the lowest levels woolly rhinoceros. These levels, corresponding to others of the same kind in other parts of Europe, are to be assigned to the last stage of the Quaternary Ice Age.

Prehistoric "Harpoon" from Scotland

A REMARKABLE barbed point of red deer antler found in the bed of the River Irvine below Shewalton Sands, Ayrshire, was described by Mr. A. D. Lacaille at a meeting of the Society of Antiquaries of Scotland in Edinburgh on December 12. The point, which may have been part of a harpoon or multi-pronged fish-spear, is believed to be the largest prehistoric point of its kind as yet recorded in the British Isles. It measures 7⅝ inches long, and is rhombic in section. It has five pairs of barbs. A groove appears on each side of a pronounced mid-rib at the tip. It has been skilfully fashioned, evidently by stone tools. The dating of the point is uncertain; but it is conjectured that it was made by settlers on Shewalton Moor, a locality rich in prehistoric and other antiquities. Both its form in section and the grooves mark a considerable technical advance on the Azilian type of barbed harpoon. Nevertheless, the Shewalton point, it is indicated, bears a general resemblance

to the harpoons of antler and bone previously found in Scotland at Oban, Oronsay and Kirkcudbright. The present find is figured in *The Times* of December 13.

Indian Cultural Studies at Oxford

WHILE the range and character of the collections of the India Museum at South Kensington will always give London a predominant position as a centre of Indian cultural studies, it should not be overlooked that the University of Oxford is not unconscious of its obligations in this direction. The report of the curators of the Indian Institute for the academic year 1937–38 states that during this period the museum has undergone a much-needed reorganization, thanks to a substantial grant from the Max Müller Memorial Fund and a generous gift from Mr. and Mrs. Spalding. The aim of the reorganization is not only to raise the character of the exhibits, but also to serve the needs of the studies carried on in the Institute, and more especially to stimulate interest in the antiquities and art of India. Among gifts and bequests, upon which the museum has to rely to a large extent, recent additions include a Buddhist shrine on loan from Mrs. Alexander Scott, which shows excellent specimens of the work of Newari and Tibetan artists, while Dr. Stella Kramrisch has lent a valuable collection of Hindu sculpture. Some interesting terra-cottas have come from the Royal Asiatic Society, and a collection of Siamese sculpture, the property of Dr. Reginald Le May, is especially instructive as a demonstration of the influence of Indian art and civilization on south-eastern Asia. Further facilities for the study of the cultural relations of south-eastern Asia will also be afforded members of the University by the valuable collection of Malayan books formed by Mr. W. W. Skeat, author of "Malay Magic", and, with Dr. C. Otto Blagdon, of "Pagan Tribes of the Malay Peninsula". This collection has been accepted by the University as a gift from Captain W. Ogilvy, by whom they were purchased for that purpose. Volumes additional to those purchased have been added by Mr. Skeat in order to enhance the value of the collection for anthropological students.

Cultivation of Plants without Soil

FOR many years it has been known that plants can be grown in nutrient solution culture, without soil, provided that the medium contains the necessary elements for growth in sufficient quantity. While this method is widely used in teaching and research work, it is only recently that attempts have been made to utilize it on the commercial scale, the idea originating in the United States. Considerable interest has been aroused by the apparent success of the methods employed in the United States, and an account of their four chief methods, namely, (1) solution culture, (2) sand culture, (3) sub-irrigation, and (4) drip culture, is given in the November issue of the *Journal of the Ministry of Agriculture*. Experiments carried out at the Jealott's Hill Research Station to determine the results of such methods under English conditions are also described. These latter tests were confined to tomatoes, and showed that some varieties are more suited to solution culture than others. There is as yet no proof that yields are as good as those obtained under the best soil conditions; but it must be borne in mind that the method, as a commercial system, is still in its infancy. Advantages claimed for the method are the elimination of soil-borne diseases, the greater control over the type and amount of growth by judicious regulation of the culture medium, and reduction in manual labour. However, the cost of equipment is a heavy item and the technique is not yet fully worked out. The experiments are to be continued, the work being extended to other crops. The results will be awaited with interest.

Smithsonian Institution Anthropological Publications

A NEW departure in publication is a series of "Anthropological Papers" consisting of articles less extended in length than the usual report on the explorations of the Smithsonian Institution, which will be numbered consecutively, and will be collected from time to time in bulletin form as occasion requires. The first issue (*Bull.* 119; 1938) contains six articles, of which the first and most considerable is a preliminary report by Mr. A. R. Kelly on the first four seasons' work of excavation on mound sites in the Ocmulgee Basin near Macon, Georgia. These excavations were undertaken originally as a measure of unemployment relief under the Civil Works Administration. The site has yielded an unanticipated wealth of material, and exploration is still in progress. Cultural development here appears, so far as present knowledge goes, to be of an extremely localized type, in which a pottery of characteristically primitive appearance is associated with an unusual type of underground house and early evidence of agriculture. Whether this represents an archaic horizon in the south-east is a moot question; but at several points it exhibits generalized resemblances with regions geographically so far distant as the Great Plains and the south-west. The remaining papers deal with a pipe ceremonial of the Arapahoes (Mr. John M. Carter), the Caribs of Dominica (Mr. Douglas Taylor), a Sauk sacred pack (Mr. Truman Michelson), the physical therapy of Soshoni of Idaho, upon which Mr. Julian H. Steward reports, and a biographical account of an Owens Valley Paiute by the same author.

Scientific Publications in Japan

A THIRD edition of a "Catalogue of Foreign Scientific Serial Publications in the Various Institutions in Japan" has just been published by the National Research Council of the Department of Education, Tokyo. The general arrangement of the work is very similar to most Union catalogues, except that whilst other publications give the holdings of each institution and an abbreviation to denote if a set is imperfect, this volume gives full particulars of the actual parts, volumes or years lacking. This feature should be of considerable service to Japanese research workers by saving them fruitless journeys, particularly as the large number of imperfections listed suggests that the proportion of incomplete

series is somewhat high. While the method of alphabetization adopted is strictly correct, it may prove in practice to be less convenient than the 'catchword' method used in the "World List", as a research worker frequently depends upon short abbreviations, and is unacquainted with unimportant particles on which the alphabetical order depends. In addition, the adoption of a strict alphabetical sequence tends to separate periodicals dealing with the same subject, which a 'catchword' method tends to bring together. The volume is well printed in a clear type, and although the titles of the periodicals are all in languages foreign to the place of publication, the work is remarkably free from printer's errors. This catalogue affords evidence of Japanese enterprise in the field of bibliography, and it is obvious that very considerable care has been taken in its compilation. It should be of much value to scientific workers resident in Japan.

The Industrial Health Research Board

THE eighteenth annual report of the Industrial Health Research Board up to June 1938 (H.M. Stationery Office. 1*s*. net) contains a summary of the results of twenty years work, and describes the work of the current year. During its twenty years of activity, an attempt has been made to discover new ways and means of improving working conditions in factories and workshops, and the results of shortening the hours of labour, of splitting up shifts and of introducing rest pauses have been studied, and the influence of environmental conditions and methods of work upon the output and the health of the workers has been investigated. During the present year, the Board has investigated the relation between illumination and industrial efficiency, problems of noise and deafness, dust and ill-health, toxic solvents, work at high temperatures and ventilation. Vocational psychology applied to vocational selection and guidance in industry, vocational tests for skilled and unskilled occupations and tests of accident proneness are other subjects to which considerable attention is now being directed.

Principal Earthquakes during 1937

IN 1937 there were no really great earthquakes, but damage was done by eight shocks, and several others were felt by human beings in various parts of the world. The eight which did damage were Guelma (Algeria), February 10; Rabaul, 4° 10′ S., 152° 10′ E. (New Britain), May 28; Maltrata (Mexico), July 26; Tsao-Tchéou (China), August 1; Manila (Philippines), August 20; Samarang (Java), September 27; Mexico City, December 23; and Oxapampa (Peru), December 29. These and others are discussed by Prof. J. P. Rothé, of Strasbourg, in *Revue pour l'Étude des Calamités*, 1, No. 2, 1938, under six regional headings: continent of Europe, Mediterranean region, continent of Asia, Asiatic islands and circum-Pacific coastlines, the American continent and the African continent with Madagascar. It is noteworthy that no disastrous earthquake was felt in Europe, and the only one reported from Britain was near Birmingham.

The Philosophical Society

THE Philosophical Society of England celebrated its silver jubilee on December 7 with a luncheon at St. Ermin's Restaurant, London, and a lecture by the Rev. I. Hartill, a vice-president of the Society, on "John Milton". Various speakers emphasized the useful purpose of the Society, its steady development and its practical achievements. Messages were sent by the American Ambassador, Lord Gorell and Prof. A. E. Heath, who were unable to attend. This Society was founded in 1913 by a group of persons interested in the moral sciences, with the view of promoting the study of philosophy among the general public. The Society publishes the *Philosopher*, holds meetings and organizes lectures from time to time. Also it encourages the formation of local centres and study circles, and the introduction of matters of philosophical interest in schools and other educational institutions. Its vice-presidents include many distinguished philosophers, and a number of eminent scholars from abroad are among its honorary fellows.

Sir George Beilby Memorial Awards

THE administrators of the Beilby Memorial Fund —the presidents, treasurers and secretaries of the Institute of Chemistry, the Society of Chemical Industry and the Institute of Metals respectively— have awarded one hundred guineas each to Dr. F. P. Bowden and Dr. Brynmor Jones. Dr. Bowden was educated at the Hutchins School, Hobart, and at the University of Tasmania. He went to Cambridge in 1927, entered Gonville and Caius College and continued electrochemical work in the laboratory of physical chemistry with Prof. E. K. Rideal and Prof. T. M. Lowry. In 1931 he was elected to a research fellowship at Caius College and was appointed University demonstrator in chemistry. In 1937 he was appointed to the Humphrey Owen Jones lectureship in physical chemistry. His electrochemical work has been mainly on over-potential and the mechanism of electro-deposition. His other work on the physical properties of surfaces has an important bearing on the problems of friction, lubrication and wear. Dr. B. Jones studied metallurgy during 1919–22 at University College, Cardiff, under Prof. A. E. Read. From 1927 until 1929 he was attached to the Metallurgical Branch of the Research Department of Woolwich Arsenal, and afterwards was appointed lecturer in metallurgy at University College, Cardiff. Dr. Jones has devised many methods in metallurgical analyses. His outstanding published work has been on the subject of the nitrogen-hardening and on the heat-treatment of steels, which has been appearing in the *Transactions of the Iron and Steel Institute*.

Physical Society's Annual Meeting

THE twenty-ninth annual exhibition of scientific instruments and apparatus, arranged by the Physical Society, will be held at the Imperial College of Science and Technology, Imperial Institute Road, South Kensington, S.W.7, on January 3–5. The leading manufacturers of scientific instruments will be exhibit-

ing their latest products in the Trade Section. The Research and Educational Section will contain contributions from research laboratories, and experiments of educational interest. In addition, the work submitted for the Craftsmanship and Draughtsmanship Competition by apprentices and learners will be on view. Discourses will be delivered at 7.45 on January 3 by Dr. J. D. Cockcroft, on "The Cyclotron and its Applications", and on January 4 by Mr. C. S. Wright, on "Geophysical Research in Polar Regions". Admission to the exhibition is by ticket only, obtainable from scientific societies or direct from the Exhibition Secretary, 1 Lowther Gardens, Exhibition Road, S.W.7.

British Association: Dundee Meeting

THE annual meeting of the British Association will be held next year in Dundee from August 30 until September 6 under the presidency of Sir Albert Seward. The following sectional presidents have been appointed: Section A (Mathematical and Physical Sciences), Mr. R. S. Whipple; Section B (Chemistry), Prof. E. K. Rideal; Section C (Geology), Prof. H. H. Read; Section D (Zoology), Prof. J. Ritchie; Section E (Geography), Mr. A. Stevens; Section F (Economics), Prof. H. O. Meredith; Section G (Engineering), Mr. H. E. Wimperis; Section H (Anthropology), Prof. W. E. Le Gros Clark; Section I (Physiology), Prof. D. Burns; Section J (Psychology), Mr. R. J. Bartlett; Section K (Botany), Prof. D. Thoday; Section L (Education), Dr. A. P. M. Fleming; Section M (Agriculture), Sir Thomas Middleton.

Colonial Service Appointments

THE following appointments and promotions in the Colonial Service have recently been made: J. E. R. Roe, veterinary officer, Uganda; T. Bell (Government Stock Farm and Agricultural Station, Acre, Palestine), agricultural superintendent, British Guiana; W. A. Gordon (assistant conservator of forests, Gold Coast), assistant conservator of forests, Cyprus; G. W. St. Clair-Thompson (assistant conservator of forests, Gold Coast), assistant conservator of forests, Uganda; J. H. Gibbons (chief inspector of mines, Northern Rhodesia), senior inspector of mines, Tanganyika Territory; K. E. Lee (assistant inspector of mines, Uganda), inspector of mines, Federated Malay States; L. Humphrey (supervisor of physical training, Sierra Leone), meteorological assistant, Nigeria.

Announcements

SIR JOHN FORSDYKE, director and principal librarian of the British Museum, and Mr. John L. Kirk, honorary director of the Castle Museum, York, have recently been elected honorary members of the Yorkshire Philosophical Society, York.

AT a reception on December 6 at the Belgian Embassy, Baron de Cartier de Marchienne, the Ambassador, presented a number of bronze medals awarded by King Leopold of the Belgians to various British scientific workers. The medals, bearing on one side the head of King Leopold and on the other the name of the recipient, and the occasion of the award, were a token of appreciation for the help given by the various specialists in classifying the natural history collections which the King of the Belgians made in 1928–29 during his voyage to the East. The recipients, most of whom were present at the Embassy, were: Sir Guy Marshall, Dr. K. Jordan, Dr. Isabella Gordon, Dr. S. Maulik, Dr. W. H. Leigh-Sharpe, Miss G. Ricardo, Mr. C. L. Collenette, Mrs. L. M. I. Macfadyn, Mr. W. H. T. Tams, Mr. H. E. Andrewes, Miss I. Meyrick (for her late father, Mr. E. Meyrick), Prof. H. Gordon Jackson, Dr. H. Hanitsch, Mr. C. J. Arrow, Dr. Evelyn Cheesman, Dr. Marie V. Lebour, Dr. Schwarz, Mr. L. B. Prout, Mr. A. J. T. Janse and Lieut.-Colonel F. C. Fraser.

DR. IRVING LANGMUIR will deliver an address before the Physical Society on December 20 at 5.15. The subject of Dr. Langmuir's address will be "The Structure of Proteins".

AN industrial fellowship has been established in the Mellon Institute, Pittsburgh, by the American Air Filter Company, Inc., of Louisville, Ky. This fellowship will aid investigations on materials of value in the construction of filters for air-conditioning systems. Dr. Frank F. Rupert, who has been appointed to the fellowship, has been a member of the Mellon Institute since 1913. Since 1935 he has been associated with the fellowship on air hygiene in the Institute.

UNDER the terms of administration of the Clough Memorial Research Fund of the Edinburgh Geological Society a sum of approximately £30 is available annually for the purpose of encouraging geological research in Scotland and the north of England. The north of England is defined as comprising the counties of Northumberland, Cumberland, Durham, Westmorland and Yorkshire. Applications for grants are invited for the period April 1, 1939–March 31, 1940, and should reach the Secretary, Clough Research Fund Committee, Edinburgh Geological Society, Synod Hall, Castle Terrace, Edinburgh, not later than February 1, 1939.

THE fourth Oxford Farming Conference will be held at Oxford on January 3–5, under the auspices of the School of Rural Economy, the Agricultural Economics Research Institute and the Institute for Research in Agricultural Engineering of the University. The general theme of the Conference will be "The Business Organization of the Farm". Further information can be obtained from the Conference Secretary, 10 Parks Road, Oxford.

THE Cambridge University Press will publish early in the New Year "A Short History of the Steam Engine", by Mr. H. W. Dickinson, formerly of the Science Museum, South Kensington. The author, it is stated, discusses not only the inventions, but also the inventors.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

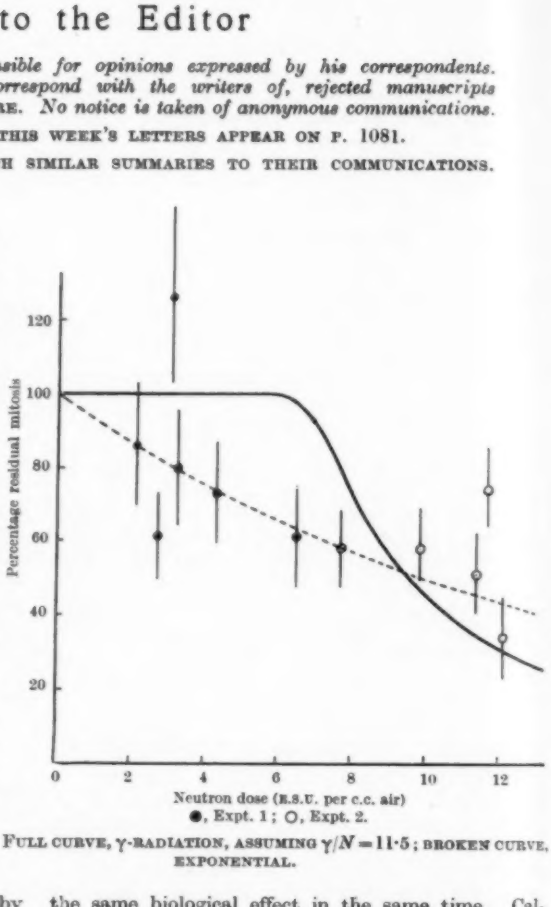
NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1081.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Biological Effect of Fast Neutrons

CHICK embryo fibroblasts have been irradiated *in vitro* by 2·4 Mev. neutrons produced by bombarding 'heavy wax' with ~ 700 microamp. of 300 kv. deuterium ions. This nuclear reaction gives rise to not more than 1 quantum of γ-radiation per 200 neutrons[1,2], and the specimens were completely protected from stray X-radiation. They were thus exposed to a practically pure beam of fast neutrons. The dose given to a culture was estimated from the radioactivity (having the decay period of radio-silicon) induced in a tiny pellet of red phosphorus placed directly above it on the cover slip of the culture slide. In a separate experiment, this radioactivity was correlated with the ionization equivalent of the neutron energy absorbed per unit volume of air, as measured by a suitable graphite ionization chamber.

The chick fibroblasts were cultivated for five days in Cambridge, and then conveyed to Northwood in a portable incubator. There the cultures were assessed in terms of their mitotic activity, and arranged in comparable batches of six cultures. In each experiment the cultures of one batch were exposed, one at a time, to the neutron beam in a separate laboratory, at room temperature, and then returned to the incubator (at 37° C.) for 80 minutes before being fixed and stained. Controls were placed on the bench at room temperature for periods corresponding to the exposure times of the irradiated specimens. One batch was placed inside the exposure box, but remote from the target, as a check on stray X-radiation. The biological effect was measured by counting all the mitotic cells in the exposed cultures and expressing the result as a percentage of the corresponding control counts. The results of the two series of exposures are shown in the accompanying table.



FULL CURVE, γ-RADIATION, ASSUMING $\gamma/N = 11{\cdot}5$; BROKEN CURVE, EXPONENTIAL.

Comparable figures for γ-radiation have been obtained by Canti and Spear[3] and Spear and Grimmett[4], from which one may calculate values of γ/N, the ratio of the γ-ray dose (in röntgens) to the neutron dose (in air-ionization units) which produces the same biological effect in the same time. Calculating this ratio for the *individual slides* using the γ-ray data of Canti and Spear, and averaging, we obtain from Expt. 1 (average residual mitosis 81 per cent) $\gamma/N = 22{\cdot}5 \pm 2$ and from Expt. 2 (average residual mitosis 54 per cent) $\gamma/N = 11{\cdot}5 \pm 1$, where the probable errors refer to relative values of γ/N. According to rough estimates, a ratio of 11·5 corresponds to the production of about the same number of ions per unit volume of tissue by neutrons and by

	Number of slides exposed	Average neutron dose (R.S.U./c.c. of air)		Average duration of exposure (min.)		Average mitotic count: Irradiated slides		Control 1		Control 2		Percentage residual mitosis	
Expt. 1	6	2·15	3·75	41	49	104	98	110	117	107	125	86	81 ± 6
		2·76		62		74		72		154		61	
		3·10		40		153		118		94		126	
		3·26		49		97		152		182		80	
		4·73		31		87		94		110		72	
		6·50		53		74		185		102		61	
Expt. 2	5	7·74	10·5	41	42	53	50	105	93	90	90	58	54 ± 5
		9·9		44		53		99		83		58	
		11·4		42		47		70		91		51	
		11·7		45		68		74		132		74	
		12·1		41		31		102		65		34	

Probable errors are estimated from the control data.

γ-rays. This large value arises, of course, from the fact that neutron energy, by contrast with γ-ray energy, is absorbed to a very much greater extent in material rich in hydrogen than in air.

We can find no explanation for the large difference between the two experimental values of γ/N other than that the *shape* of the mitosis-dose curve is not the same for neutrons and γ-rays. This is evident from the figure, in which mitosis is plotted against dose for the individual slides. The full curve shows Canti and Spear's results for γ-radiation at comparable intensity, from which it is seen that if the neutron curve were of the same shape as the γ-ray curve, none of the doses delivered in Expt. 1 should have produced any diminution in mitosis, whereas in fact five out of six slides showed marked reduction in mitosis, the average reduction being 19 ± 6 per cent. So far as we are aware, this is the first occasion on which a difference between the mode of action of neutrons and γ-rays has been reported.

The neutron points appear to define an approximately exponential curve. If this is interpreted as implying that mitosis is inhibited by the passage of a single proton through a specially vulnerable region, the diameter of this region can be estimated at about 3 μ. Furthermore, because the number of ion pairs per unit volume required to reduce mitosis to 50 per cent is approximately the same for neutrons and for γ-rays, it follows that provided approximately 1,500 ions are produced within this volume, it is immaterial whether the ions are produced along a straight track or at random. That is, the biological effect is not the result of the direct ionization by the proton or by secondary electrons of a group of molecules which are indispensable for the performance of mitosis.

Obviously, many more measurements are necessary to establish the exact shape of the neutron mitosis-dose curve, but as we cannot continue the experiment for six months, owing to the absence of one member (F. G. S.), we wish to direct attention to the important conclusions which would follow if our provisional estimates are substantiated. The effect of neutrons on the mitosis of bean root cells is being investigated at the Mount Vernon Hospital, in collaboration with Dr. J. C. Mottram.

We gratefully acknowledge the financial assistance of the British Empire Cancer Campaign towards the construction of the neutron generator.

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[1] Kallmann and Kuhn, *Naturwiss.*, **26**, 106 (1938).
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Structure of the Crystals of Tomato Bushy Stunt Virus Preparations

WE have examined by X-ray methods crystals of the protein material prepared by F. C. Bawden and N. W. Pirie[1] from tomato plants suffering from bushy stunt disease. The crystals were in the form of isotropic rhombic dodecahedra of average diameter of only 0·01 mm. Consequently, no attempt was made to take single crystal photographs. Instead, powder photographs were taken of a suspension of the crystals in their mother liquor. With a monochromatic beam of copper $K\alpha$ radiation at 40 cm. plate distance and long exposure, two lines were observed of spacings 279 A. and 160 A. respectively. The ratio of these spacings is $\sqrt{3} : 1$, corresponding to the (110) and (112) spacings of a body-centred cubic lattice of side 394 A. This would correspond to a particle diameter of 340 A. or a radius of 17 mμ. Although the (200) reflection and higher order reflections are not observed, the attribution of a body-centred cell is probable as it accords with the dodecahedral habit by Fedorov's law.

The density of the crystals in solution was determined as 1·286; the wet molecular weight is therefore, assuming two particles per cell, 24,000,000. On drying and rewetting, the crystals can be observed to shrink and swell reversibly. The amount of shrinkage measured under the microscope was 80 per cent of the wet dimensions. An X-ray photograph of a specimen dried over phosphorus pentoxide showed a cell of side 318 A., giving almost exactly the same degree of shrinkage. This is, we believe, the first time that the shrinkage of a crystal on drying has been shown to be the same as the change in the lattice dimensions measured by X-rays. If the density of 1·35 computed by A. S. McFarlane and R. A. Kekwick[2] is assumed to be that of the dry crystals, this would give a molecular weight of 12,800,000. This is considerably higher than the value of 8,800,000 found by them by the centrifuge method. The discrepancy may be due to some of the water in the crystal being held zeolitically and lost without further shrinkage. To obtain their molecular weight the density of the dry crystals would have to be 1·12 and the wet crystals would contain 63 per cent of water.

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Transformation of α- and β-forms of 3:6-Anhydro-methyl-Galactosides

THE transformation into α- and β-forms in equilibrium is the usual result of the digestion with methyl-alcoholic hydrogen chloride of either an α- or β-methylglycoside. This change is generally attributed to the initial hydrolysis to the free sugar followed by a mutarotation and the regeneration of the two forms of the methylglycoside.

We have recently encountered an example of a substance which does not appear to conform to this interpretation of the isomeric change. This substance is 2:4-dimethyl 3:6-anhydro-α-methyl-*d*-galactopyranoside, a liquid showing $[\alpha]_D + 73°$ in water and +99° in ether. It was prepared by methylation of 3:6-anhydro-α-methyl-*d*-galactopyranoside which was obtained by alkaline treatment of 6-tosyl α-methylgalactopyranoside. The anhydro compound is mentioned also by several other workers[1,2,3]. We

have found that the liquid dimethyl 3 : 6-anhydro-α-methyl-*d*-galactopyranoside changes, by a brief contact with air containing a trace of hydrogen chloride, to the corresponding crystalline β-form, namely, 2 : 4-dimethyl 3 : 6-anhydro-β-methyl-*d*-galactopyranoside (m.p. 82°; $[\alpha]_D - 77°$ in water, −87° in chloroform, −81° in methyl alcohol). Both forms appear, by ebullioscopic methods, to be monomeric, and this is confirmed for the β-form by X-ray examination.

The same isomeric change from α- to β-form was effected by the addition of a drop of a solution of hydrogen chloride in ethyl alcohol or in ether. The velocity of this change is apparent from the fact that with gaseous hydrogen chloride or hydrogen bromide the syrupy α-form appears to pass instantaneously into the crystalline β-form, although the solid mass of the product still contains some of the α-form. Inasmuch as there is no loss of methyl from the glycosidic group during these transformations, it is clear that the mechanism does not admit of a stage which passes through the free sugar. Moreover, we have prepared the same crystalline substance, namely, 2 : 4-dimethyl 3 : 6-anhydro-β-methyl-*d*-galactopyranoside by following the procedure observed for the α-form, except that we started from β-methylgalactopyranoside. It is evident, therefore, that the transformation product derived from the α-form is the true β-form. When either the α- or the β-form is treated with methyl-alcoholic hydrogen chloride (2 per cent), at room temperature or at boiling point, polarimetric observations show the rapid establishment of equilibrium of the two forms, and fission, if any, of the 3 : 6-anhydro-ring does not occur to an appreciable extent. The presence of the 2 : 4-dimethyl residues seems to stabilize the 3 : 6-anhydro-ring in the presence of acid reagents. The corresponding glucose derivative, 3 : 6-anhydro-methylglucopyranoside, does not display with acid reagents instability of the anhydro-ring.

Detailed examination of 3 : 6-anhydro-ring forms has recently assumed a new importance inasmuch as an enantiomorph in the *l*-galactose series has been isolated from a study of the hydrolytic products of agar-agar[3,4]. Recognition of 2 : 4-dimethyl sugars in the form of their methylglycosides has become a live problem for the reason that we have required these sugars in order to identify the components having 1 : 3- and 1 : 6-glycosidic links which, in the course of our work during the past five years, have been found to occur in the polysaccharide derived from gum arabic. Both the α- and β-forms of 2 : 4-dimethyl 3 : 6-anhydro-methyl-*d*-galactopyranoside are rapidly hydrolysed by dilute acids. From the β-form, 2 : 4-dimethyl 3 : 6-anhydro-galactose, m.p. 112°, was isolated, and this gives the anilide, m.p. 123°, and also, by oxidation, the corresponding 2 : 4-dimethyl 3 : 6-anhydro-galactonic acid and its amide, m.p. 151°.

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3 : 6-Anhydro-*l*-galactose in Agar

IN continuation of our former communication[1] we are now able to confirm that the substance (*X*) derived from agar is a derivative of 3 : 6-anhydro-*l*-galactose as recently advanced by Hands and Peat[3]. 3 : 6-Anhydro-β-methyl-*d*-galactoside, m.p. 118°, $[\alpha]_D^{20°} = -113°$ in water has now been synthesized from the crystalline triacetyl 6-*p*-toluenesulphonyl α-*d*-galactosyl-1-bromide ($[\alpha]_D = +157°$) of Ohle and Thiel[2] by treatment with silver carbonate and methyl alcohol followed by deacylation with sodium hydroxide. Methylation of this substance yielded quantitatively crystalline 2 : 4-dimethyl 3 : 6-anhydro-β-methyl-*d*-galactoside, m.p. 82°, $[\alpha]_D^{20°} = -77°$ in water, −86° in chloroform, which is undoubtedly the enantiomorph of (*X*), since the properties are the same but the sign of the rotation is reversed (mixed m.p. 65°). We have obtained further confirmation of this point by the preparation of the anilides of the dimethyl anhydro sugars, 2 : 4-dimethyl 3 : 6-anhydro-*d*-galactose anilide having m.p. 118°, whilst the corresponding derivative from agar had m.p. 117° strongly depressed on admixture with the *d*-anilide. Furthermore, the properties and stability of the lactones produced on oxidation are in agreement with these findings, so that the substance (*X*) must be regarded as 2 : 4-dimethyl 3 : 6-anhydro-β-methyl-*l*-galactoside.

The preparation of 2 : 4-dimethyl 3 : 6-anhydro-α-methyl-*d*-galactoside was described in our former letter[1] and isolated as an oil, $[\alpha]_D = +87°$ in chloroform, and both this oil and the crystalline substance synthesized above reach the same equilibrium ($[\alpha]_D^{20°} = +22°$) in cold *N*-sulphuric acid. It has also been found that this oily 2 : 4-dimethyl 3 : 6-anhydro-α-methyl-*d*-galactoside is very sensitive to traces of acid; contact with cold methyl-alcoholic hydrogen chloride causes a remarkably rapid fall in optical rotation and the crystalline β-form can then be readily isolated.

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"Methyl Epiglucosamine" and 2-Amino α-Methylaltroside

DURING recent years, a series of papers from this laboratory have shown that derivatives of glucose may be converted smoothly into derivatives of altrose, galactose and gulose by means of optical inversion within the molecule[1]. In each case the key substance to such a conversion has been an anhydro-compound of the ethylene oxide type in which the ring is broken under the influence of alkali. For example, 2 : 3-anhydro 4 : 6-benzylidene α-methylalloside or 2 : 3-anhydro 4 : 6-benzylidene α-methylmannoside, in our experience, invariably yield derivatives of altrose when treated with alcoholic caustic potash or sodium methoxide solution.

We are now able to report that an analogous series of reactions may be carried out with derivatives of galactose, and that various crystalline derivatives of idose have thus been obtained (Robertson and Tetlow, unpublished result).

As a natural consequence of this work, we extended our researches to the action of ammonia on 2 : 3-anhydro 4 : 6-benzylidene α-methylmannoside and 2 : 3-anhydro 4 : 6-benzylidene α-methylalloside. The former, on treatment with ammonia, gives a quantitative yield of *3-amino 4 : 6-benzylidene α-methylaltroside*, m.p. 188°, $[\alpha]_D + 88{\cdot}9°$ in chloroform ($c = 0{\cdot}517$). When the benzylidene residue is removed from the above substance by means of 1 per cent hydrochloric acid, *3-amino α-methylaltroside hydrochloride* is obtained in 76 per cent yield. The substance has m.p. 209° with decomposition, $[\alpha]_D -$ 149° in water ($c = 1{\cdot}028$), and is identical with the "methyl epiglucosamine hydrochloride" prepared by Fischer, Bergmann and Schotte[2], who record m.p. 210–211° with decomposition, and $[\alpha]_D - 147°$ in water. Fischer's "methyl epiglucosamine" has since been proved to be 3-amino α-methylaltroside by Freudenberg, Burkhart and Braun[3].

In analogous fashion, 2 : 3-anhydro 4 : 6-benzylidene α-methylalloside gives a quantitative yield of *2-amino 4 : 6-benzylidene α-methylaltroside*, m.p. 168°, $[\alpha]_D + 104{\cdot}7$ in chloroform ($c = 1{\cdot}346$). The above was in turn converted into *2-amino α-methylaltroside*, m.p. 193°, $[\alpha]_D + 107°$ in chloroform ($c = 1{\cdot}109$), in 70 per cent yield. The position assigned to the amino group in the above case has not yet been definitely proved, but from analogy with the action of alcoholic caustic potash and sodium methoxide solution on 2 : 3-anhydro 4 : 6-benzylidene α-methylalloside, there can be little doubt that the amino group is in position 2.

Full details of the above transformations will be published shortly.

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Nov. 7.

[1] Mathers and Robertson, *J. Chem. Soc.*, 1076 (1933); Robertson and Griffith, *J. Chem. Soc.*, 1193 (1935); Oldham and Robertson, *J. Chem. Soc.*, 685 (1935).
[2] *Ber.*, **53**, 541 (1920).
[3] *Ber.*, **59**, 714 (1926).

A New Synthesis of Aromatic Arsenic Compounds

IN the course of a systematic study of reactions between aryl diazonium chlorides and chemical elements, it has been found that aromatic arsenic compounds may be prepared by warming a diazonium chloride under acetone with arsenic powder and chalk. With benzene-diazonium chloride there is obtained a water-soluble product from which triphenylarsine sulphide has been obtained by precipitation with hydrogen sulphide.

The reaction with arsenic is therefore analogous to that with antimony[1], which yielded triarylstibine dichlorides and other aromatic antimonials. However, when antimony powder is used, the reaction sets in at 0°, but with arsenic powder there is no reaction in the cold. There is a similar difference in degree of reactivity with the elements tellurium and selenium[2], which follow antimony and arsenic in the Periodic Table.

The reaction with bismuth powder has also been investigated, but, although the bismuth is attacked when the mixture is heated, aromatic bismuthines do not seem to be formed. They may, however, be unstable under the conditions of the reaction.

Attention has already been directed to the theoretical significance of these reactions[3], and of the reactions with metals such as mercury and silver, which may be attacked by free chlorine atoms but would not be affected if the decomposition of the aryl diazonium chloride took either a molecular or an ionic course. A still more striking example of the reactivity of the chlorine has now been found; gold powder is also attacked by benzene-diazonium chloride under acetone kept neutral with chalk, and auric chloride is formed in considerable quantities.

In contrast, it is rather curious that thallium metal seems to be inert, for aromatic thallium compounds can easily be prepared.

The scope of this new synthesis of aromatic arsenicals is under investigation in these laboratories.

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Nov. 15.

[1] Makin and Waters, *J. Chem. Soc.*, 843 (1938).
[2] Waters, *J. Chem. Soc.*, 1077 (1938).
[3] Waters, NATURE, **140**, 466 (1937); *J. Chem. Soc.*, 2007 (1937).

Alimentary Exudative Diathesis

DURING the work on K-avitaminosis in chicks, it is often observed that in some animals large amounts of transparent fluid accumulate, for example, in the subcutaneous connective tissue. It has now been possible to produce this symptom systematically by using a diet from which the protein has been very thoroughly extracted by alcohol.

The accumulations of fluid may be found in all parts of the body, but most frequently on the breast and abdomen. They are located in the subcutaneous connective tissue or under the skin and in some cases under the fasciæ of muscles. Intra-peritoneal accumulation is rare.

The fluid has the same composition as blood plasma, and it often clots when being removed by a pipette. In some cases the coagulation has already taken place *in vivo*.

Simultaneously with the accumulation of fluid, hyperæmia, slight hæmorrhage and accumulation of leucocytes occur in connective tissue, chiefly in fat tissue under the skin, in mesenteric fat or in fat tissue on the serosa of the gizzard. A similar condition may also, but less frequently, be seen in muscle tissue. Other tissue has not been observed to be affected. The changes resemble a sterile inflammation. It has not been possible to propagate any micro-organism from the inflamed tissue or from the fluid.

The fluid is supposed to originate by exudation from such inflamed tissue in which the capillary wall is rendered abnormally permeable. The degree of permeability is such that the plasma may escape while the erythrocytes are only passing through to a limited extent.

When chicks weighing 100–130 gm. are fed the basal diet, 50–80 per cent of them will show the symptom after 6–30 days. The exudates often disappear in about a week, even if the food is not changed, and some of the animals get several attacks during the experiment.

Addition of hesperidin together with ascorbic acid to the diet does not prevent the symptom, and it is therefore not likely that the disease is due to deficiency in Szent-Györgyi's vitamin P.

Neither is it likely that the disease is due to lack of vitamin K, because it has been observed in chicks receiving 0·1 per cent of petrol ether extract of alfalfa in addition to the basal diet. Such a diet contains 20–30 units of vitamin K per gm., an amount which secures normal blood clotting and prevents the 'ordinary' hæmorrhage of K-avitaminosis. 40 per cent of dried yeast in the diet gives no protection.

The resemblance of the symptom to an allergic reaction might suggest that the protein had been rendered toxic by the extraction process, for example, by being altered in such a way that a trace is absorbed without being broken down by the digestive enzymes.

However, certain observations make it probable that the exudative diathesis is a deficiency disease. Thus the addition of 5 per cent dried alfalfa or 0·5 per cent petrol ether extract or alcohol extract of alfalfa afforded a very material reduction of the percentage of the animals showing the symptom, while 1·5 per cent aqueous alfalfa extract or 0·5 per cent alfalfa ash gave no protection.

These and other observations suggest that the disease is prevented by a specific petrol ether- and alcohol-soluble factor occurring in dried alfalfa, but that this material is no powerful source. It is therefore proposed to attempt to find a richer source of the protective factor and to concentrate and differentiate it in the usual way.

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Trimethylamine Formation in Relation to the Viable Bacterial Population of Spoiling Fish Muscle

Suwa[1] and Poller and Linneweh[2] found that the trimethylamine oxide occurring in the muscle of certain sea fishes is reduced to the corresponding volatile amine during its spoilage by bacteria. Recently, Beatty[3] has shown that it is fairly certain that at least 94 per cent of the trimethylamine found in decomposing cod fish muscle arises from the trimethylamine oxide present in this tissue, and not from the other possible precursors. Sterile fish muscle[4] and muscle press juice[5] do not reduce the oxide.

These, and similar observations made by other investigators, have led to the suggestion that the simple determination of the amount of trimethylamine in sea fish muscle might prove a convenient and accurate chemical test by which its stage of decomposition could be accurately judged[5,6,7], and attempts have been made to compare the viable bacterial counts (or the logarithms of these counts) with the amount of trimethylamine in cod fish muscle press juice[5] or in spoiling haddock muscle[7].

Recent work at this station[8] has shown that, while there is undoubtedly an increase in trimethylamine as the viable bacterial population of lightly smoked sea fish fillets increases, there is by no means a constant relationship between these two values. It seemed possible that not all bacteria occurring in spoiling fish muscle are capable of reducing trimethylamine oxide, and that the discrepancy noted above might well be due to an unequal distribution of the reducing and non-reducing organisms in different samples of fish.

In order to investigate this possibility, thirty micro-organisms (15 micrococci, 4 flavobacteria, 6 achromobacteria and 5 yeasts) were isolated at random from fresh halibut and red cod muscle, and from smoked fillets of halibut, red cod and grey cod. Only three of these organisms (2 species of micrococci and 1 achromobacter) formed trimethylamine when grown in dilute aqueous halibut muscle extract sterilized by filtration, or when washed suspensions of their cells were incubated anærobically in Thunberg tubes in the presence of halibut muscle juice, with or without added trimethylamine oxide, at *p*H 7·0 for 16 hours at 25° C. Under the last-named conditions, the reduction of the oxide by the three cultures capable of effecting its reduction was found to be linear and practically quantitative, suggesting the presence of a specific dehydrogenase enzyme (or enzymes) catalysing the reaction. By inoculation of aseptically excised cod fish muscle with trimethylamine-forming and non-trimethylamine-forming species of *Micrococcus*, samples of fish with either high or negligible quantities of trimethylamine, but with high bacterial counts in both instances, have been obtained.

From these results, it would seem unlikely that the trimethylamine content alone will prove to be a satisfactory criterion of the degree of bacterial contamination of sea fish muscle, unless the population of trimethylamine-forming to non-trimethylamine-forming bacteria proves to be fairly constant in all cases. As yet the full mechanism of the bacterial reduction of trimethylamine oxide to trimethylamine remains to be determined, though recent work by Watson[9] suggests that the lactic or pyruvic dehydrogenase systems are capable of catalysing this reaction.

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Nov. 1.

[1] Suwa, A., *Pflüger's Arch. Ges. Physiol.*, **128**, 421 (1909).
[2] Poller, K., and Linneweh, W., *Ber.*, **59**, 1362 (1926).
[3] Beatty, S. A., *J. Fish. Res. Bd. Canada*, **4**, 63 (1938).
[4] Brocklesby, H. N., and Riddell, W. A., Prog. Rep. Pacific Fish Expt. Stn., No. 33, 17 (1937).
[5] Beatty, S. A., and Gibbons, N. E., *J. Biol. Bd., Canada*, **3**, 77 (1936).
[6] Boury, M., and Schvinte, J., *Rev. Trav. Off. Pêches Mar.*, **8**, 282 (1935).
[7] Shewan, J. M., Rep. Director Food Invest. Bd. (London), Sec. 4, p. 75 (1937).
[8] Tarr, H. L. A., and Sunderland, P. A., Prog. Rep. Pacific Fish Expt. Stn., No. 37, 7 (1938).
[9] Watson, D. W., cited by Beatty, S. A., *Chem. and Ind.*, **57**, 865 (1938).

A Correlation between the Chemical Constituents and Morphological Structure of certain *Thesium* Species

A CHEMICAL examination of *Thesium virgatum* has been carried out, and two characteristic constituents of the plant tissues have been isolated—a phlobatannin, and an amorphous substance which yields glucose and a steam-volatile oil on hydrolysis. These constituents are readily detected in the plant material by a test tube reaction, the phlobatannin with mineral acids yielding a red phlobaphene, and the glycosidic material the free essential oil.

Three of the four sections of the *Thesium* genus mentioned in the "Flora Capensis" are represented in the Cape Peninsula. In general, these sections are well defined; but the boundaries between them are not absolute. In an attempt to follow the gradation from group to group chemically, the above qualitative test has been applied to the vegetative portions of a number of *Thesium* species. Arranging

the species roughly in the order of evolutionary development as given in the "Flora Capensis", the following results were obtained.

Section I. Imberbia, comprising the species, *crassifolium*, *corymbuligerium*, *ericæfolium*, *nigromontanum*, *commutatum*, *virgatum*, *strictum*. All these contained the essential oil glycoside and the phlobatannin. Section II. Barbata, comprising the species, *paniculatum*, *euphrasioides*, *cuspidatum*, *acuminatum*, *scabrum*, *pubescens*, *capitatum*. Only *paniculatum* contained the essential oil glycoside, but all except *scabrum*, *pubescens* and *capitatum* contained phlobatannin. Section IV. Annulata, comprising the species, *funale*, *aggregatum*, *spicatum*, none of which contained either substance.

Although complete seasonal variations have not yet been studied, there seems to be a definite correlation between the structure of the *Thesium* flower and the chemical constituents of the plant. In Section I, we have the 'open' type of flower, and with progression to the 'closed' type, there is gradual disappearance of the essential oil glycoside and phlobatannin, through intermediate types such as *T. cuspidatum* and *T. euphrasioides* which contain phlobatannin alone.

A more detailed account of an examination of the essential oil derived from the glycosidic extract from *T. virgatum* will be published elsewhere.

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Nov. 5.

Double Ovaries in Some Chinese Birds of Prey

IT is generally believed that, in the normal condition, there persists only a single gonad, the left ovary, in female birds. But bilateral ovaries are not uncommon in hawks and some species of other birds. The finding of such paired ovaries in European and American birds, and even in African birds, has already been recorded. So far as I know, however, very little has been recorded on the bilateral development of ovaries in Oriental birds. The following is a list of birds of prey which were collected in the Western Hills, near Peiping (Peking), China, and examined by me in October last. It may be of interest to students of embryology and comparative anatomy, as well as to those who are engaged in the study of birds.

Name of Species	No. of females examined	No. of ovaries
Circus cyaneus cyaneus (Linn.)	13	2
Accipiter nisus nisosimilis (Tickell)	2	2
Buteo hemilasius (Temminck and Schlegel) ..	2	1
Buteo burmanicus burmanicus Hume ..	2	1
Aquila clanga fulvescens Gray	1	2
Milvus lineatus lineatus (Gray)	1	1
Cerchneis tinnunculus japonicus (Ticehurst)	7	1

Of the seven species examined, three species only possess two ovaries, and the remaining four species have only a single ovary.

There was no exception in species with paired gonads. Of the thirteen specimens of hen harrier (*Circus cyaneus cyaneus*) examined, all had two ovaries. This is also true in the case of the Asiatic sparrow-hawk (*Accipiter nisus nisosimilis*) and great spotted eagle (*Aquila clanga fulvescens*).

The materials thus studied were secured during the autumn migration, so that the gonads are not well developed. All the eggs are more or less uniform in size, and generally speaking, they are rather small.

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Effect of Collisions on the Intensities of Nebular Lines

MENZEL[1] has recently stated that "There appears to be a widespread misconception concerning the effect of electron collisions on the intensities of forbidden lines". In the conventional treatment to which the above statement objects, the intensity is given by the formula

$$I = \frac{MA_{21}h\nu}{A_{21} + b_{21}} = \frac{Mh\nu}{1 + b_{21}/A_{21}}, \qquad (1)$$

where M is the number of atoms excited to the upper state per unit of time, A_{21} is the probability of spontaneous emission and b_{21} is the probability of removal from the upper state by collision with electrons, atoms, molecules, etc. b_{21} in general increases with the density of these particles and is proportional to the density if the composition and velocity distribution are not altered. In this case, I remains approximately at the value $Mh\nu$ as long as the density is so low that $b_{21} \ll A_{21}$. When $b_{21} \gg A_{21}$, however, $I = MA_{21}h\nu/b_{21}$, that is, I falls off inversely as the density if M, the rate of excitation of atoms excited to the upper state, is held constant.

Menzel considers there is a fallacy in holding the rate of excitation M constant, and proposes the use of the formula for I,

$$I = N_1 \frac{\omega_2}{\omega_1} e^{-h\nu/kt} \left(\frac{1}{1 + A_{21}/b_{21}}\right) A_{21}h\nu \qquad (2)$$

By the use of this formula, Menzel postulates that the rate of excitation, M, of atoms to the upper state is proportional to the electron density. With this assumption the intensity increases with the density at densities that are so low that $b_{21} \ll A_{21}$ and asymptotically approaches a constant value at higher densities where $b_{21} \gg A_{21}$. Thus as Menzel states, "I reaches a maximum when the electron density is high".

Formula (2) gives the intensity for the case in which both the excitation and de-excitation of N_1 atoms is caused by impacts with an electron gas having a Maxwellian velocity distribution corresponding to a temperature T. The formula is not sufficient to discuss the conditions under which thermodynamical equilibrium is reached, since the effects of absorption and induced emission are neglected. If they are included, it can easily be seen that, for any finite value of the electron density and the transition probability, the bracketed factor in (2) becomes unity only when the radiation density has the value prescribed by Planck's law for the temperature T. Only the Boltzmann factor appears then in (2). This, of course, is merely an example of the well-known fact that in complete thermodynamic equilibrium the density of radiation at any wavelength is a function of temperature alone and is independent of the probability of spontaneous emission of any line that happens to fall at the wavelength, and of the electron density. The formula does not apply to any laboratory case since it neglects the effect of de-excitation by atoms, molecules, walls

of discharge tubes, etc., which play a major part in laboratory sources. Even in astronomical sources its applicability is very limited, since it requires that the energy available for excitation must increase in a prescribed way as the density is increased.

Comparing the density of radiation given by the mechanism postulated by (2) with that of complete thermodynamic equilibrium, it is evident that at low electron densities the permitted (A_{21} large) and forbidden (A_{21} small) lines depart equally from the equilibrium case. At high electron densities, however, de-excitation by collision causes the forbidden lines to depart much farther from the equilibrium case than the permitted lines.

Which of these treatments, M constant or M proportional to density, one uses is largely a matter of personal preference, since neither can lay claim to any uniqueness in describing either astronomical or laboratory phenomena. Indeed equally strong claims can be made for considering the intensity coming from unit volume, in which case the number of atoms capable of being excited (N_1 in 2) also increases with the density. M then becomes roughly proportional to the square of the density, and an even greater increase of I with the density is obtained than that given by (2).

The important facts which hold true in all of these cases are:

(1) At low densities where de-excitation by collision is negligible, the number of quanta emitted is practically equal to the number of atoms excited regardless of whether the lines are permitted or forbidden. Because of the lower excitation potential of the forbidden lines, they become under these conditions the true resonance lines of the atoms or ions concerned. The forbidden lines therefore take a very major role since a large part of the available energy is transferred to them.

(2) At high densities the excitation of the forbidden lines remains large. Because, however, of the very high probability of de-excitation by collision compared to the probability of spontaneous emission, only a negligible fraction of the atoms excited succeeds in emitting forbidden lines. Under these conditions, therefore, practically all of the available energy appears in the permitted lines.

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[1] NATURE, 142, 644 (1938).

Photochemistry of Ammonia

THE mechanism of the photochemical decomposition of ammonia has been the subject of considerable discussion lately[1], from which it would appear that the nature of the reaction is almost completely elucidated. The experiments to be mentioned below were designed to settle the few remaining uncertain points regarding the reaction. In point of fact, however, they have opened the results to a new interpretation.

The relevant experimental evidence, discussed in the references cited above, may be summarized thus. From the diffuse nature of the absorption spectrum and the absence of fluorescence, it was concluded that each molecule on absorbing a quantum dissociated into NH_2 and H. The low quantum yield—for example, 0·3 at 20° C. and 100 mm. pressure—was interpreted as due to a back reaction, which was supported by the fact that atomic hydrogen inhibited the reaction. Using para hydrogen to measure the stationary concentration of atomic hydrogen, it was found that this concentration was much smaller than that calculated on the assumption that H atoms disappear by the reactions $H + H + X \rightarrow H_2 + X$ and $H + NH_2 + X \rightarrow NH_3 + X$, where X is a third body. This anomaly was explained by assuming that NH_2 radicals combine to form hydrazine, which in turn rapidly reacts with atomic hydrogen, thereby maintaining a low stationary atom concentration.

In order to compute the magnitude of this latter process, the effect has been measured of hydrazine on the stationary atomic hydrogen concentration (estimated by para hydrogen conversion) produced by photo-excited mercury atoms. The results showed that the low concentration is not due to hydrazine, for the pressure of hydrazine required to account for the low concentration of hydrogen atoms could not possibly be formed during the course of a normal ammonia experiment.

This point was made doubly sure in the following way. If hydrazine is responsible for the low concentration, then ammonia *undergoing photo-dissociation* should also inhibit the para hydrogen conversion photo-sensitized by mercury atoms. A mixture of ammonia and para hydrogen was therefore exposed first to a mercury resonance lamp and then simultaneously to the lamp and to a zinc spark which dissociated the ammonia. There was no appreciable inhibition of para conversion when the ammonia was being dissociated, even though conditions were such that inhibition of ammonia decomposition by atomic hydrogen could be detected.

The conclusions to be drawn from these experiments are that the low hydrogen atom concentration is not due to the presence of hydrazine, which substance plays no significant part in the photo-chemistry of ammonia, except under special conditions, and that the secondary reactions only involve $H + H \rightarrow H_2$, $NH_2 + NH_2 \rightarrow 2H_2 + N_2$ and $H + NH_2 \rightarrow NH_3$.

Another series of experiments gave the probable clue to the dilemma. Using the same intensity of radiation for exciting mercury atoms and for dissociating ammonia, it was observed that the ratio of the rates of para hydrogen conversion is very nearly equal to that expected if only one quarter of the ammonia molecules absorbing light yield the products NH_2 and H.

These experiments therefore suggest that only a fraction (given approximately by the quantum yield) of the ammonia molecules undergo primary dissociation to H and NH_2, which react in the fashion mentioned above. The remainder lose their energy by chemically ineffective processes.

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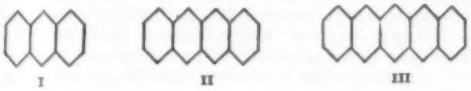
[1] Taylor, H. S., *J. Phys. Chem.*, **42**, 783 (1938). Leighton, P. A., "The Determination of the Mechanism of Photochemical Reactions", 27 (Paris: Hermann et Cie).

Fluorescence of Solids

THE following observations may be of interest in view of the present interest in problems of fluorescence of solids. Anthracene (I) in the solid state fluoresces blue with a high efficiency, the absorption band lying at wave-lengths shorter than 3800 A. Solid naphthacene (II) is yellow in colour and fluoresces very faintly, and solid pentacene (III) is dark bluish and does not fluoresce appreciably. In dilute solid solution in anthracene, however, the latter hydrocarbons fluoresce vividly, the former greenish-yellow and the latter red.



I II III

The chief point of interest is that this fluorescence is stimulated by light absorbed by the anthracene, while the blue anthracene fluorescence is almost entirely suppressed. These phenomena closely resemble those observed with a typical inorganic fluorescent solid such as zinc sulphide, the emission of which is completely changed by minute additions of copper, etc.

It seems, one must suppose, that an electron free to move is liberated by absorption of light within the anthracene crystal, and that the positively charged anthracene molecule quickly regains an electron (without emission) by an exchange through the crystal from a distant napbthacene or pentacene molecule. The latter molecule, now minus an electron, emits its characteristic fluorescence when a free electron returns to it. Since the crystal structure of anthracene is well understood, it is possible that these phenomena are capable of theoretical treatment.

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Points from Foregoing Letters

Dr. F. G. Spear, Dr. L. H. Gray and Dr. J. Read report that the relation between the dose and the percentage residual mitosis in *in vitro* cultures of chick embryo fibroblasts after irradiation with D-D neutrons is not the same as the sigmoid relation found for γ-radiation, but is more nearly exponential. An exponential relation would be anticipated in the case of neutron irradiation if inhibition of mitosis resulted from the production of about 1,500 ion pairs in a volume of about 3 μ in diameter.

X-ray study of crystals obtained from 'tomato bushy stunt' virus preparations indicate, according to Prof. J. D. Bernal, I. Fankuchen and D. P. Riley, a particle size of 340 A. diameter and a molecular weight of 24 million, for the wet particle of density 1·286. If the density of 1·35 computed by McFarlane and Kekwick is assumed to be that of the dry crystals, it would give for these a molecular weight of 12·8 million, a substantially larger figure than the value of 8·8 millions derived from experiments with the ultracentrifuge.

The almost instantaneous change of the syrupy alpha form into the crystalline beta form of the 2 : 4-dimethyl 3 : 6-anhydro-methyl-*d*-galactopyranoside in presence of traces of gaseous hydrochloric acid indicates, according to Prof. W. N. Haworth, J. Jackson and Dr. F. Smith, that the usual mechanism assumed for such transformation, namely, initial hydrolysis to the free sugar followed by a mutarotation and the regeneration of the two forms of the methylglycoside, does not apply in this case.

Dr. E. G. V. Percival and I. A. Forbes confirm that the substance recently isolated from agar is a derivative of 3 : 6-anhydro-*l*-galactose. They have synthesized its enantiomorph, 2 : 4-dimethyl 3 : 6-anhydro-β-methyl-*d*-galactoside, which has the same properties but opposite optical rotation.

Various crystalline derivatives of idose have been prepared from galactose derivatives by Dr. G. J. Robertson, W. H. Myers and W. E. Tetlow by employing an anhydro-compound of the ethylene oxide type in which the ring is broken under the influence of alkali. They have further prepared 2-amino α-methylaltroside and 3-amino α-methylaltroside hydrochloride, the latter identical with 'methyl epiglucoseamine hydrochloride'.

Dr. W. A. Waters reports that aromatic arsenic compounds are formed when arsenic powder is warmed with an aryl diazonium chloride under acetone containing chalk. Under the same conditions gold is also attacked and yields auric chloride, but thallium seems to be inert.

Chicken fed upon a diet in which the protein has been very thoroughly extracted by alcohol may develop in the connective tissues large accumulations of transparent fluid, of the same composition as the blood plasma. Dr. H. Dam and J. Glavind consider that this is the effect of a deficiency disease.

It is stated by Dr. H. L. A. Tarr that only certain, and probably a small proportion, of the micro-organisms which are commonly associated with decomposing sea fish muscle are able to reduce the trimethylamine oxide occurring therein to trimethylamine. This fact probably accounts for the finding that there does not always appear to be a close correlation between the viable bacteria count and amount of trimethylamine in this medium.

P. C. de Kock and Prof. W. S. Rapson find that in various species of the South African genus *Thesium* the presence or absence of the easily identifiable chemical constituents phlobatannin and/or glycosidic material, corresponds to the grouping of those species according to the structure of their flowers and other morphological characters.

Prof. I. S. Bowen and Dr. R. Minkowski suggest that Menzel's recent discussion of the effect of collisions on the intensities of nebular lines is based on a special case, in which the apparent increase in intensity of forbidden lines with density is a result of the assumption that the rate of excitation increases with the density. They emphasize that, while forbidden lines take a major role at low densities, de-excitation by collisions prevents them from emitting an appreciable fraction of the available energy at high densities.

Research Items

Jades from Central America

A NUMBER of the jades bequeathed to the British Museum by the late Mr. T. W. Gann are figured and described by Mr. T. A. Joyce in the *British Museum Quarterly*, **12**, 4, 1938. This collection of Central American carvings in jadeite and basalt is said to be one of the finest ever acquired over a number of years by a single individual. The sites from which they were obtained are unfortunately not defined with accuracy; but they obviously come from the Central Maya area, and in the main from British Honduras. They illustrate the extraordinary facility with which the early inhabitants of Central America, ignorant of the use of iron, could carve hard stone. The finest piece, a jadeite plaque, represents a seated chief in full regalia, with an attendant, in the style which is associated with Copan, and recalls the seated figures represented on a lintel from that site, now in the British Museum. It is clear that the plaque has been trimmed, possibly owing to an accidental breakage in early times. Ornaments of this class were regarded as heirlooms and much treasured by later generations owing to the fact that jadeite seems to have become exceedingly rare. A basalt mask exhibiting a high degree of skill in modelling was evidently inlaid with other materials to represent eyes and teeth, but as in most other examples, the inlay has disappeared. Incised lines on cheeks and chin probably represent designs painted on the face. Some of the pendants representing a human head enclosed in the jaws of a monster are symbolical of the earth, which swallows the sun every evening. There are no glyphs to give a clue to the dating of the pieces; but evidently they antedate considerably the discovery of America. An 'eccentric' flint from the collection is described as the most remarkable example of stone-flaking technique which has yet come from Central America.

Studies in Alcohol

W. W. JETTEN (*Amer. J. Med. Sci.*, **196**, 475, 487; 1938) carried out two series of observations. The first, which was concerned with the diagnosis of acute alcoholic intoxication by a correlation of clinical and chemical findings, was made on 1,159 consecutive persons admitted to hospital with a diagnosis of acute alcoholism. In 1,150 cases, blood was obtained for analysis, and in 381 the urine was also examined. The results were as follows. Alcohol was found in the blood of 1,000 cases and in all the 381 cases in which the urine was examined. Of the 1,000 cases with alcohol in the blood 779 (77·9 per cent) were found in the concentration groups of 0·15 to 0·30 per cent alcohol inclusive, and of the 381 cases in which the urine was examined 266 (70 per cent) showed a concentration of 0·20 to 0·35 per cent alcohol inclusive. Clinical intoxication was found in the blood series in approximately 10 per cent of the cases with a concentration of 0·05 per cent alcohol; in 18 per cent at 0·10 per cent alcohol, in 47 per cent at 0·15 per cent alcohol; in 83 per cent at 0·20 per cent alcohol; in 90 per cent at 0·25 per cent alcohol; in 95 per cent at 0·30 per cent alcohol and in 100 per cent in a concentration group of 0·45 per cent alcohol. The second group of observations consisted in the determination of the alcohol content of the blood at regular intervals following ingestion of 1, 1·25, 1·5 and 2 c.c. of alcohol per kgm. of body weight in twenty non-alcoholic individuals, that is, occasional drinkers or total abstainers. Jetten found that acute clinical intoxication occurred in 50 per cent of the cases in which the alcohol concentration in the blood ranged from 0·075 to 0·125 per cent, in 57 per cent in concentrations from 0·125 to 0·175 per cent and in 100 per cent in concentrations from 0·175 to 0·225 per cent alcohol. The incidence of acute clinical intoxication in these non-alcoholic individuals at low alcoholic concentrations was much higher than the incidence at similar concentrations in a larger group of chronic alcoholics.

Conjugal Tuberculosis

H. COUËTOUX (*Thèse de Paris*, No. 387; 1938) has made a study at two dispensaries in Nantes of 816 married couples, of whom one at least was tuberculous, and found that in 112 (13·72 per cent) the other partner was also affected. In the adult population of Nantes, calculation of probabilities showed that if there were no question of contagion between husband and wife, the rate of tuberculous infection among couples would be 1·69 per cent. Comparison of these two figures shows that the first member of the married couple to contract tuberculosis is responsible for infection of the second in 12·03 per cent of the couples in which tuberculosis is present. Conjugal contagion, therefore, is the most important factor in the causation of tuberculosis in the second member of a married couple.

Eggs of the Komodo Lizard

IN the Sourabaya Botanical and Zoological Gardens in the Dutch East Indies are four specimens of the giant lizard, *Varanus komodœnsis*, two of which have been there since 1927 and two since 1935. In July 4, 1937, individuals were seen in copulation and by August 13 it was discovered that the female, which had been placed in an enclosure with abundance of humus, had laid two eggs which turned out to be addled (*Treubia*, **16**, 365, August 1938). Later, a nest of eggs was found in the heap of humus; one egg was extracted and found to weigh 136 grams, but the others did not hatch, and when the nest was opened in January 1938, only 14 desiccated parchment-like egg-shells were revealed. This excavation, however, revealed a second nest with 10 eggs. One of these was examined at the time and contained a living embryo which had not become immersed in the mass of light yellow yolk. The remainder, left to develop, were found five weeks later to be shrivelled, but six contained embryos in various stages of development, the largest measuring 27 cm. from snout to tip of tail. The authors, E. L. Tänzer and Jhr. W. C. van Heurn, consider that the embryos died at an early stage of development, and that the cause of death was some deficiency in the humus environment. It is to be hoped that future results will be more successful, for the development of a skull so curious as that of the Komodo lizard is a matter of great interest.

Brackish-water Fauna of Orkney

THE lochs of Stenness and Harray present an interesting biological problem, for while they are connected with each other and, by way of Stenness, open into the sea, they present very different aspects of brackish-water conditions. Both receive fresh-water streams, but the former is partly tidal, and its fauna and flora have a predominantly brackish character throughout an area which at the time of examination by Dr. Edith A. T. Nicol showed salinities varying from 9 to 26·8 parts per thousand (*Proc. Roy. Soc. Edinburgh*, **58**, 181; 1938). On the other hand, the Loch of Harray receives a contribution of sea-water only at spring tides, and as a consequence is almost fresh (salinity 0·6–4·3 parts per thousand) and possesses a fauna and flora almost wholly composed of freshwater species. The two lochs are the only Scottish localities for the mollusc *Neritina fluviatiles*, and the dwarfing effect of brackish conditions is seen in the miniature size of this species and of *Mya arenaria*. *Hydrobia jenkinsi*, present in both lochs, appears to be a recent immigrant.

Sheep Population of South Australia

THE number of sheep present in South Australia has been recorded yearly since the foundation of the Province in 1836. Dr. J. Davidson has analysed these records and compared the data with the Verhulst-Pearl logistic curve expressing the course of the growth of a natural population (*Trans. Roy. Soc. S. Australia*, **62**, 141, 1938). The progress of sheep numbers during the past hundred years, while showing for the first forty years a rapid and steady increase which coincided with the theoretical growth of a population, began to exhibit marked fluctuations from the normal curve so soon as the limit of density was approached. Saturation density of the sheep population which a natural pasture can carry is determined in the main by the feeding value of the pasture and the regrowth of plants eaten by the sheep. When the density exceeds this value the balance is upset and the carrying capacity of the area will decline. Recovery of numbers depends upon the degree of overgrazing and the power of the pasture to recover. In the arid climate of South Australia recovery is mainly dependent upon rainfall, and may be considerably delayed.

Role of Fructosans in Carbohydrate Metabolism

IN a recent study of the interrelationship of sucrose, glucose and fructose (including fructosans) in the barley plant (Archbold, H. K., *Ann. Bot.*, N.S., **2**, 183, 403; 1938), attention is once more focused on the question of interconversion of these sugars in stems and leaves. The methods of sugar determination are reviewed in the first paper, and the results presented in the second. The observation that, while the concentration of reducing sugars decreases from apex to base in the stem, that of fructosan and of sucrose rises, entirely supports the view that fructosans are secondary in origin, in spite of the fact that they are here found in leaves; and that they arise from reducing sugars and not from sucrose. Any condition which limits the demand for soluble sugars (for example, removal of ears, nitrogen deficiency, etc.) causes an increased accumulation of fructosan in the leaves, where under normal conditions it is present only in small amounts. It is shown that in leaves no conversion of fructose to glucose is necessary to account for polysaccharide production, provided that fructose is the sole source of carbon for respiration, and largely for protein synthesis. In stems, however, such a conversion does seem necessary. On the other hand, the formation of fructose from temporarily immobilized sugar seems to necessitate conversion of glucose to fructose, a process which may be reversed when sugars are again in demand.

Morphology of *Sorghum* Species

A STUDY of the internode and sheath lengths of *Sorghum* species by Rangaswami Ayyangar and his co-workers has shown that, in general, the longer the species is in reaching maturity, the taller the plants and the greater the number of internodes (*Proc. Ind. Acad. Sci.*, **7**; 1938). On the basis of these measurements, they divide the *Sorghum* species into three groups; in group 1, including the early species, the internode length shows a steady increase from the base of the plant to the peduncle; in group 2, the medium species as regards maturity, the internode length increases up to a peak, then falls before increasing again to the peduncle; whilst in group 3, the late species, the internode length rises to two peaks before finally rising to the peduncle. Thus groups 2 and 3 show a unimodal and bimodal distribution of internode lengths respectively. The internodes are apparently measured from ground-level; for greater exactitude, it would have been useful to indicate the position of the first internode measured relative to the internodes produced by the shoot above the coleoptile. The sheath lengths give the same general distribution as internode lengths, but to a less marked extent. The tillers do not necessarily show the same internode distribution as the main axis; in some bimodal species, the tillers, with their shorter growing period, have a unimodal distribution. In breeding, short stems, early maturity, coupled with unimodal distribution, behave as simple dominants to tall stems, late maturity and a bimodal distribution of internode lengths.

Mould Fungi of the Punjab

H. CHAUDHURI has recently published a detailed annotated list of moulds of the Punjab (*Proc. Ind. Acad. Sci.*, Sect. B, **8**, No. 2, Aug. 1938). Sixteen species of the genus *Penicillium* are described, and with the collaboration of M. Umar, 31 species of *Aspergillus* are further considered. Cultural and microscopical characters are given in detail for many of the important species, whilst references to further work are cited for all. The mould flora of the Punjab contains some indigenous elements, but many of the species described are widely distributed. Species of *Aspergillus* and *Penicillium* which occur in India, but have not so far been recorded in the Punjab, are included in the papers, thus making them, in effect, part of a mould flora of India.

Plant Diseases of Greece

THE *Verticillium* wilt of cotton is distributed over wide regions where the host can grow, but the advent of this disease to Greece is somewhat puzzling. J. A. Sarejanni discusses the question in a paper entitled "La Verticilliose du Coton en Grece" (*Ann. Inst. Phytopathologique*, Benaki, 2nd year, 2nd fascicule, 79–85; 1936). Native Greek cotton is immune to attack by the fungus *Verticillium alboatrum*, but several American varieties were introduced a few years ago. These were quickly attacked by the wilt

fungus, and after a survey of possible sources of infection, it is concluded that spores of the organism were either carried upon the fibres surrounding the seed, or were present in the water of irrigation. The latter method, though implying wind transmission of spores over considerable distances, appears to be the more likely, as the cotton seed was disinfected against *Bacterium malvacearum*, which treatment should also kill the spores of *V. alboatrum*. The same author also announces, in subsequent notes, the discovery of *Septoriella oleicola*, a newly described parasite of the olive, and *Microdiplodia capsici*, a new species parasitic on pimento.

Recent Earthquakes recorded at Hamburg

DR. E. TAMS reports that earthquakes have been recorded recently at Hamburg as follows: (1) Nov. 5d. 8h. 55m. 34s. *P* compressional epicentral distance 9,300 km. (2) 5d. 11h. 2m. 24s. *P* compressional epicentral distance 9,300 km. (3) 6d. 9h. 6m. 0s. epicentral distance 9,000 km. (4) 6d. 27h. 50m. 57s. *P* compressional at epicentral distance of 9,000 km. (5) 9d. 9h. 28m. 11s. *P* dilatational epicentral distance 9,100 km. All the times are in G.C.T. These confirm the readings from Kew and Stuttgart given previously and probably refer to an epicentre or epicentres under the Pacific Ocean to the east of Japan.

Acetylcholine Hydrolysis

CONTINUING their work on the kinetics of choline esterase *in vivo*, Clark and Raventós (*Quart. J. Exp. Physiol.*, **28**, 155 and 177; 1938) have compared the rate of hydrolysis of acetylcholine by strips of frog's auricle with the rate of recovery of the heart from stimulation of the vagus nerve. It is suggested that a single stimulus to the nerve releases around each heart cell some 20,000 molecules of acetylcholine, most of which is destroyed by hydrolysis. The hydrolytic process is a relatively slow process, 5–10 sec. being required to reduce the concentration of the acetylcholine liberated to half. The contracture evoked in the skeletal muscle of the frog by application of acetylcholine, similarly, is a long-lasting phenomenon, and the authors consequently doubt the existence in muscle of an enzymic system capable of destroying, within a few milliseconds, the acetylcholine liberated at the endings of a motor nerve.

Flavour and Aroma of Butter

CONTROL of the physical condition of butter is more or less a mechanical function, and large differences in texture are rarely encountered. Flavour and aroma, on the other hand, are determined by a complex of biological, biochemical and chemical reactions and in consequence may vary widely. E. G. Pont has recently discussed some of these problems (*J. Australian Inst. Agri. Sci.*, **4**, No. 3, 131). Generally speaking, butters may be divided into two groups, one being full flavoured, acid and prepared by a starter containing bacteria, the other being mild, slightly acid or even alkaline, for which no starter is required. The former is largely produced in Denmark and many other Continental countries, whereas the latter is manufactured almost entirely in Australia and New Zealand. Fullness of flavour, however, appears to be directly dependent on the diacetyl content of the butter, brought about by the complex fermentation processes induced by the starter. Unfortunately, the series of auto-oxidative reactions do not cease at the desired point, with the result that starter butter has not nearly such good keeping quality in cold storage as the non-starter type. The chief problem, therefore, is to find some means of improving the flavour without reducing the keeping quality. Since diacetyl itself, in the concentrations found in butter, does not actively promote deterioration, there is no fundamental reason why the flavour of the mild type of butter could not be intensified without affecting its other desirable qualities. There are, however, considerable technical and other difficulties in the way, but in view of the fact that on the English market (which absorbs the bulk of the Australian butter) a product with a full flavour always commands the better price, the point is considered worthy of further attention.

Hydration of Vitamin B_1

THE water of crystallization of vitamin B_1 (which is deliquescent) has been variously given as one half, one, or approximately one, molecule of water per molecule of vitamin. W. A. Bastedo, N. R. Trenner and T. J. Webb (*J. Amer. Chem. Soc.*, **60**, 2303; 1938) have determined this magnitude by different methods. They find that the results of dissociation pressure measurements are liable to lack of reproducibly owing to minor details in the preparation of the vitamin, such as methods of removing solvent, etc. Standardized procedures were adopted, but it was found that slight variations in the aqueous pressures to which the samples were exposed gave rise to appreciably variable water contents of the vitamin, indicating that the problem was not one of an ordinary system of hydrates. The degree of hydration corresponded with about 0·4 per cent of water at 1 mm. pressure of vapour and varied continuously to 5·2 per cent at 19 mm. At the vapour pressure of the saturated solution, 20·9 mm., the degree of hydration corresponds approximately to one molecule of water of crystallization per molecule of vitamin.

Paths of Ions in the Cyclotron

IN the cyclotron, particles are introduced near the centre of a magnetic field and are accelerated by a periodic electric field applied between two semicircular electrodes. The particles describe closed circuits in time with the alternations of the field, so that they are accelerated at each revolution and the size of their orbits continually increases. If the velocities are so high that the relativity value of the momentum differs appreciably from mv, the time of description of a circuit in a uniform field will increase with increasing velocity and the particles will get out of phase with the electric alternations unless the magnetic field increases radially. It has been shown by Bethe and Rose that a radially increasing field exercises a defocusing action on the ions, causing them to diverge on either side of the median plane. This effect sets a limit to the velocities usefully obtainable with the cyclotron. L. H. Thomas now shows (*Phys. Rev.*, **54**, 580; 1938) that a variation of the field with polar angle may introduce a compensating focusing effect. The required variation is of the order v/c, and the variations considered in the paper are a function of the radius and have period $\pi/2$ in angle. It is shown that the resulting orbits for the particles are stable, and that the focusing obtained is not upset by the presence of the electric field. The Bethe-Rose defocusing limitation on the performance of the cyclotron can therefore be removed in principle.

Molecular Films*

THE forces between molecules of organic liquids of non-ionic type are ordinarily of such short range that they act only when the molecules are in contact. The magnitude of the force depends mainly upon the area, and the nature of, the two contacting molecular surfaces. This principle of independent surface action has been a useful guide in the development of theories of surface tension phenomena and should be equally valuable for theories of vapour pressures and solubilities. It leads directly to the concept of molecules having hydrophobic and hydrophilic parts which spread as oriented monolayers on a water surface.

Such monolayers can have the properties of two-dimensional gases, liquids or solids. A type of film called a duplex film, having no three-dimensional analogue, has two interfaces (an upper and a lower), which are separated by a thin three-dimensional layer (the interstratum).

Expanded films, such as monolayers of myristic acid on acidulated water, are duplex films in which the interstratum is a hydrocarbon liquid. The lower interface contains all the hydrophilic groups. These, because of thermal agitation, constitute a two-dimensional gas that exerts a surface pressure, causing the expansion of the film.

Many proteins, although very soluble in water, form remarkably insoluble monolayers which are duplex films. The interstratum consists of polypeptide chains which form loose loops attached at intervals to the upper interface by hydrophobic groups. These give to the upper interface the properties of a two-dimensional gas. When the monolayer is compressed, some of the hydrophobic groups are driven from the upper interface into the interstratum. The irreversible formation of the monolayers indicates that the globular proteins have an entirely different structure and gives support to the cyclol theory.

The viscosities and elasticities of monolayers furnish information regarding the cross linkages between the chains.

Stearic acid spread on water containing traces of barium salts gives monolayers which can be deposited by a dipping process upon solid plates. By successive dips, any number of layers, up to 3,000, can be built up. Optical measurements, involving interference of light reflected from the top and bottom surfaces, give accurately the thickness of the film.

Single monolayers of various substances, deposited upon barium stearate multilayers of critical thickness (about ¼ wave-length), are readily visible to the naked eye because of the change of colour. With monochromatic light the thickness of the monolayer can be measured to within about 2A.

The barium stearate multilayers are both hydrophobic and oleophobic (non-wettable by oil). Dipping into dilute solutions of thorium nitrate causes an overturning of the outside layer of molecules, making the surface polar and hydrophilic. Such conditioned surfaces can absorb many organic substances from solution, giving observable increases of thickness. This technique serves as a valuable tool in biological investigations.

Free stearic acid in barium stearate multilayers can be dissolved out by dipping the film into benzene containing 1 per cent alcohol, leaving a skeleton of unchanged thickness, but of refractive index which may be as low as 1·2. The application of a drop of oil fills the pores of the skeleton without wetting the surface and restores the original colour. Films of many substances may be deposited upon skeleton films and the permeability of the deposited films to liquids or vapours can thus be measured optically.

* Substance of the Pilgrim Trust Lecture delivered by Dr. I. Langmuir, For. Mem. R.S., before the Royal Society on December 8.

A Primitive Philosophy of Life*

IT has been rather the fashion of recent years to make too light of what is known as the comparative method in anthropology, used with such effect by Sir Edward Tylor and perfected by Sir James Frazer. So much of the work Frazer has done in that field is now taken for granted, that we are perhaps too prone to forget that but for the comparative work done by him, much of the intensive investigation into particular areas which is now possible would scarcely have begun to take place. In the present lecture, a hypothesis is put forward in regard to certain conceptions on which Sir James has had much to tell us—conceptions of life.

That conception of life which forms the subject of the lecture was first thrust on Prof. Hutton's attention when investigating the head-hunting practices of the Naga tribes of Assam. The Karen apparently regard the soul as leaving the body and proceeding to the underworld, where eventually it becomes a vaporous substance in a bladder or egg, which bursts, and the contents spread over the fields, fertilizing the developing flower of the rice plant and other herbs of the field. This seems to embody a conception of life as a material finite substance—a vaporous matter, limited in form and extent, and on the possession of which the propagation and renewal of life depends. It is to be noticed that this condensation of the life substance does not take place immediately after death, but the shade of the deceased continues to exist in a land of shades as a sort of separable soul, before the pupating process, which precedes the next manifestation of the psyche as a sort of fertilizer of vegetation. Clearly the belief of the Karens is not

* A Primitive Philosophy of Life. By Prof. J. H. Hutton. (The Frazer Lecture, 1938.) Pp. 24. (Oxford: Clarendon Press; London University Press, 1938.) 2s. net.

rudimentary but has been the subject of speculation and elaboration.

This idea of the Karens does not stand alone, but has many parallels, particularly in the Indonesian area. The notion of dew as embodying life seems to be widespread, and was not unfamiliar in Great Britain, for example, in the seventeenth century. One of the most meticulous and detailed beliefs about life-material, or 'soul-substance', is recorded among the Kai of what was formerly German New Guinea. Life-material is there identified with the shadow, the reflection and the personal name, and appears to reside in every part of the body, saliva, excreta, the glance of the eye and even the voice. This idea is not foreign to civilized ideas, for it appears in Plato's "Timæus", and is said to be found in the Taoist philosophy of China, while in the Vedanta philosophy of Hinduism, the body is the exterior of a series of sheaths encasing the soul, of which the interior less material sheaths accompany it on its migrations.

Soul material is particularly strong in certain parts of the body, particularly the head. In San Cristoval, one soul emerges from the head after death, a round stone or fossil being used as a receptacle, in which it is placed among the family gods, or, it may be, in the fertilizing waters of a river. The other part of the soul similarly goes into a sacred stone of a baetylic nature, just as the soul in so many Naga tribes enters the wooden statue on the grave, or the memorial stone erected in the rice fields. A third possible destination for the San Cristoval souls is the mandible of the deceased. Hence the mandible of a dead chief is preserved to bring luck in hunting, or to remind them of the duty of blood revenge. The importance of the lower jaw is widespread in Indonesia, and extends to Polynesia, while in West Africa the possession of the mandible gives power over the ghost.

These beliefs in the selective location of the soul-substance in the head, and its relation to fertility, are basic in the practice of head-hunting. The Kwotto seem to state specifically that the enemy head is abstracted in order to transfer to the decapitator, or rather to his community, the virility and power of the slain, and so to build up a sort of virility-power reserve, to be drawn on as the community requires.

In many instances the life material is in the blood; and Sir James Frazer mentions many instances wherein the blood of the killed is partaken of by the killer, as well as carefully avoided, because it contains the life of the dead animal. The liver, the heart, the brain, or the eye are regarded as seats of life by various races. In parts of Papua a man will choose to eat particular parts of the body to reinforce some weakness of his own; while elsewhere people stand under the platform of the deceased to absorb his qualities by anointing themselves with the putrescent fat. Cannibalism, as an act of mourning, may also arise from this same soul-substance notion, as in Australia survivors are urged to eat portions of their dead, so as not to disturb the camp with their mourning.

That life material is regarded as present in grain is indicated by the abhorrence with which the code of Manu regards the act of pounding or grinding it, while in Indonesia plants are regarded as having soul-substance similar to that of man. Many tribes plant a coconut at the birth of a child, when the soul substance of the child is bound to the tree as it grows up. Similarly in Africa, there are stories of the transference of a soul to a plantain tree by means of the placenta planted at its foot, and in India of the fertilization—pollination as it were—of women from the flower of jasmine, or by the petals of the rose tree growing from the tomb of some long-buried saint.

Human sacrifice is clearly traceable in many cases to this same belief in life as a finite substance to be transferred from one person to another, or to vegetation and livestock. Human sacrifice, it has been pointed out, seems to be particularly closely associated with agriculture. It is possible that the association between the souls of dead ancestors and the crops is to be traced to some practice of collecting wild grass seeds and leaving them by the dead as a provision for the future, and the observation of their germination and growth. It has been suggested that the practice of agriculture may have started in this way. It is therefore not inconceivable that the desire to provide for a crop of food grains may have sometimes led to the slaughter of an individual to afford a good grave.

Another aspect of the idea of life as something concrete and finite is in its separability from the body. Hence it must be conceived in some sort of form; and we find it commonly as bee, butterfly, firefly or beetle. It seems clear then that from this conception may arise a philosophy of the soul, conceived in zoomorphic or anthropomorphic shape; while its situation in various parts of the body gives rise to the idea of a multiplicity of souls. From this the way is open to the development of every form of animism, polytheism, or monotheism, to say nothing of a conception of metempsychosis and a future life. Again, from this source are likely to develop theories of nagualism and lycanthropy, at any rate of the kind found in Assam and West Africa; also the idea that the collective soul of the herd may be specially associated with a single individual, as in Indonesia one animal is the leader, or a *Ficus* tree in a grove is considered the chief, who takes care that the soul substance of the other trees does not vanish. So the leader of a community could be the special receptacle of the communal life material, and totemism, so often associated with the external soul, would then be traceable to the same idea. It is possible that ideas about incest, so difficult to account for, may be derived from the same idea, for exogamy is necessary to amass fertility and life from outside the community; while for kings, incestuous marriage was enjoined, whether in order to keep the tribal life pure, or as Sir James Frazer suggests, to maintain hereditary right to rule, which has been vested in the female line.

A first stage in abstraction leads to the idea of life as a force or power, *mana*, then, perhaps inevitably, to taboo, while one aspect of the soul substance doctrine tends directly to sympathetic magic, as action on hair, nails, spittle, etc., affects the whole, of which it formed a part.

Question arises how did this idea originate. It seems probable that limitations of language have played a part in determining ideas as to life and soul. Primitive language is very rich in concrete terms, but poor in abstract. No doubt the lack of any terms other than concrete ones, representing a similarly restricted mental imagery, has been largely responsible for the idea of life as a concrete finite element and, therefore, for the idea of soul substance.

National Parks

AT a meeting of the Linnean Society held on December 8, the objects of national parks were discussed. The immediate cause of the discussion was a letter from Prof. J. B. Cleland, chairman of the Commissioners of the National Park at Belair, South Australia, who asked for "an authoritative definition of a National Park" and an expression of opinion as to how far facilities for sport and recreation should be allowed to replace the original flora and fauna, especially when the Park is near a large city.

Prof. T. G. B. Osborn, a former commissioner, gave an account, illustrated by lantern slides, of the Park at Belair. It is an area of 2,000 acres in the hills to the south-west of Adelaide, about eight miles by road from the city. Its history as a park dates from 1891, but the area has been preserved in a semi-wild state since shortly after the foundation of the Colony in 1837. Formerly known as the 'Government Farm', it served as a depot for horses of the Police and Survey Departments. The western end is relatively level, with open eucalypt forest (red gums, manna gums and peppermint) and grassy undergrowth. This is the part which has been most influenced by grazing of horses and clearings for sports grounds. From this area, which lies at about 850 ft. altitude, two narrow, steep-sided valleys run into the eastern part, which in one corner reaches 16,000 ft. The valley bottoms have been largely cleared of timber, though magnificent specimens of the original gums are left. Exotic trees have been planted among them, and the growth of grass encouraged. Here again, sport facilities and picnic facilities have been provided. Most of the steep valley sides and surrounding hills are relatively unaltered and have a covering of stringy-bark or pink gum trees with shrubby undergrowth. Some 350 species of indigenous flowering plants and ferns, including about 50 species of terrestrial orchids, have been recorded.

An area of seasonal swamp is of special interest as a habitat of the rare lycopod, *Phylloglossum*, and a terrestrial *Isoetes*. A measure of the interference with the flora is seen in the 150 species of alien plants naturalized in the Park. The indigenous mammalian fauna is probably extinct, but many interesting reptilian species remain. Eighty-one species of birds have been recorded. Like other parts of the Mount Lofty Ranges, the Park is liable to damage from fires during the dry season. The indigenous vegetation recovers rapidly after burning, but frequent forest fires open the way to invasion by alien species. Grazing by horses helps to keep the grass short, and so reduces the danger of fires during the dry season. The Commissioners have not a large grant for maintenance, so they welcome the fees from depasturing horses. A considerable addition to revenue is obtained from the hire of sports grounds, tennis courts, and pavilions for picnics.

Sir Peter Chalmers Mitchell, speaking on behalf of the Society for the Preservation of the Fauna of the Empire, defined a national park as an area under public control, with unalterable boundaries, in which wild animal and plant life is preserved, and hunting or collecting only allowed under licence. He agreed that there is need to modify the definition to meet the case of smaller areas near towns, for it is unreasonable to expect that an area so situated should be left exclusively for naturalists.

Dr. Julian Huxley pointed out that this definition was meant primarily for Africa. As a member of the Standing Committee for National Parks of the Council for the Preservation of Rural England, he emphasized that a national park in Great Britain should be an extensive district of beautiful landscape left in traditional usage. Whilst in Africa the preservation of flora and fauna might be the chief object, in England possibilities for recreation, walking and camping in unspoilt countryside must take precedence. In his opinion, the Park at Belair in South Australia is too small to fulfil the functions of a national park, but it should be possible to restrict games to certain areas, and to establish sanctuaries in the wilder parts. The ideal of a national park for England embracing an extensive district (50–200 square miles) of wilder countryside, was developed by Mr. John Dower of the Committee for National Parks. The aim would be to preserve the beauty of landscape, allow access to the people and afford general protection of wild life.

Dr. G. Herbert Smith, speaking for the Society for the Promotion of Nature Reserves, said that, small though the Park at Belair is, its use for recreation and æsthetic enjoyment is not necessarily incompatible with protection of flora and fauna.

Prof. F. E. Weiss urged the importance of localizing sporting facilities and motor traffic and of maintaining strict reserves within the park for plants of special scientific interest. Mr. C. A. Gardner pointed out that one such reserve exists near W. Albany, Western Australia, for the preservation of *Cephalotus*, the endemic pitcher-plant. He emphasized the difficulty of conserving the Australian flora, owing to the fact that it is readily modified by recurrent fires and human access. Mr. H. I. Burkill reported an unsuccessful attempt to conserve an area of natural jungle in the Botanic Gardens, Singapore.

The inevitability of change was stressed by Dr. W. T. Calman, who pointed out that Nature is dynamic, not static, and that, unless the traditional occupations of the countryside are maintained, the flora and fauna of any reserve in Britain will alter in a few years.

Summing up, Dr. J. Ramsbottom said that the term 'Nation's Park', first used in America in 1842, was intended to mean an area of country left in its 'pristine state'.

Replying to the criticism of the inadequate area of the National Park, Belair, Prof. Osborn said that South Australia has also a flora and fauna reserve of about 200 square miles at the western end of Kangaroo Island. The vegetation and animals of this differ from those of the Mount Lofty Ranges; hence the importance of the small reserve at Belair.

Count Kaspar Sternberg, 1761-1838

BORN at Prague on January 6, 1761, Kaspar Sternberg was destined for the Church, and to that end studied theology at Freising and Rome. When scarcely twenty-two years of age, he obtained an appointment at Regensburg and gave promise of rapid advancement. Turning his attention, however, to natural science, he began a thorough study of botany in connexion with certain forestry duties allotted to him. He collected and cultivated wild plants and acquired an extensive scientific library. In 1810 he published his first monograph, "Revisio Saxifragarum".

In the same year, following the death of his elder brother, Sternberg returned to Bohemia, taking his herbarium and library with him. From this time onwards he lived alternately in Prague and at his country seat, Březina Castle near Radnice in West Bohemia, maintaining a keen interest in science and supporting its extension and application to local industries. He began the agitation for a national museum and became its first president when it was founded in 1818, a post he retained until his death. He appointed Palacký as secretary of the National Museum Society, K. B. Presl as curator of the natural history collections and later (1836) A. J. Corda to take charge of the zoological section, whilst Presl was left with the botanical part. Sternberg gave his own herbarium and mineral collections to the Museum and also impoverished himself in the purchase of the collections of others to make it as representative as possible. Thus he bought the 15,000 specimens collected by the Bohemian explorer Thaddeus Haenke, and engaged Presl and F. M. Opiz to classify and describe them, financing their "Reliquiæ Haenkeanæ", which appeared in two sumptuous volumes in 1825 and 1835.

At his castle near Radnice, Sternberg amassed a wonderful library, which has passed into the possession of the Bohemian National Museum, and he laid out botanical gardens, including hot-houses for tropical plants. The coal deposits of Bohemia were attracting attention at this time and Count Sternberg investigated the formation of coal and described many fossil remains of plants in his "Flora der Vorwelt" (1820–38) which he wrote with the assistance of the Presls and Corda, and which remains a phytopalæontological classic. It was not his first work in this field, for he had already communicated papers to French and German journals on the analogies between fossil and living plants.

Sternberg's interest in the application of science to industry is shown in his "Outline of the History of Mining and Mining Laws in the Kingdom of Bohemia". This monumental work appeared in two parts in 1836 and 1838, and the frontispiece to the first depicts Wenceslas II handing a document of mining rights to miners in 1300, whilst at the end is a map of Bohemia in 1500 showing the centres of gold-, silver- and other mining activities. In the preface he urged the necessity for scientific and technical education as a means of checking wasteful methods in working the mines.

Most of Sternberg's works were in German, though he supported what Czech publications there were and he encouraged the printing of text-books and treatises in that language. His last public function was to preside at the medical congress at Prague in 1837, on which occasion he advocated the greater application of science in the study of medicine. His memory is perpetuated by the name sternbergite assigned to the mineral, an argentiferous pyrites, discovered by Haidinger in 1826.

Count Sternberg died at Radnice on December 20, 1838, after a full and useful life.

Air Conditioning in Deep Mines

AT a joint meeting of the Institution of Mechanical Engineers and the Institution of Chemical Engineers held on May 17, a paper entitled "Engineering Problems associated with the Improvement of Temperature and Humidity Conditions of the Atmosphere in Mines at Great Depths" was presented by Dr. J. H. Dobson and Dr. W. J. Walker. In it were raised points of world-wide importance in connexion with mining operations which are carried on where wet bulb temperatures of mine atmospheric air approach 90° F. and approximate to normal blood temperatures. The task of the engineer is to produce satisfactory conditions for underground workers in these extremely difficult conditions, and the authors explained the complexity of the problem and gave a brief account of the research which has been devoted to it.

In describing the conditions to be dealt with, the considerable progress made in modifying them and the trend of future developments, the Witwatersrand goldfields were cited as an object lesson by the authors, who presented the subject in broad outlines with the view of stimulating interest in this work and encouraging suggestions towards a solution of the intricacies involved in it. The present working levels at these mines are from 6,000 to 8,000 feet, and Rand mining engineers hold that depths of 12,000 feet are within economic possibilities. Owing to the nature of the dust, silicosis has to be guarded against and the wet system of mining is employed. This means that there must be copious supplies of water at the drills, at all working points and wherever dust may occur. This condition, taken in conjunction with the high virgin rock temperatures in restricted spaces with a limited circulation of air, points to the fundamental nature of the problem. To present an idea of the magnitude of the heat inflow, the authors estimate, in relation to a mine at a depth of 6,000 feet from which the monthly output is 150,000 tons of rock, that, from all sources, 70,000,000 B.Th.U. per hour

may be expected. Of this total a large percentage has to be extracted in order to adapt the underground atmospheric conditions to the health and physical efficiency of the workers.

Three methods in operation were described. At the Robinson Deep Mine, a surface refrigeration plant is used which deals with 407,000 cubic feet of air per minute, cooling it from 65°/60° F. wet bulb temperature to 38°/33° F., the cooled air being sent down the downcast shaft to a depth of 7,500 feet. Underground refrigeration is adopted at the East Rand Proprietary Mine and the plant treats more than 8,000 tons of air per day, cooling it from 81° to 72°. As a contrast to these systems, dehumidified compressed air is used at various mines of the Anglo-American Corporation by employing it at every possible machine underground. This eliminates one source of heat in the use of electric motors, and from the practical point of view offers a much simpler system at the hot spots than any of the others. Devaporization of the air is effected by over-compression. It is first compressed to 90 lb./in.^{2} abs. and then taken to an over-compressor where it is raised to 130 lb./in.^{2} abs. It next passes through a cooler, the first water separator, the heat exchanger where it is further cooled, and a second water separator from which it goes to the expansion turbine. Then after passing through a third water separator and the heat exchanger it goes to the compressed air pipes in the downcast shaft.

As the wet method of mining is responsible for a substantial portion of the problem presented, the authors also discussed the relative advantages which would accrue from the adoption of drier methods and dealt with the concomitant problem of the prevention of dust.

Preservation of Antiquities of South Africa

WITH the view of safeguarding the evidence of antiquity in South Africa, the Minister of the Interior of the Union of South Africa has published orders prohibiting the removal or export of monuments, relics, or antiques without the written consent of the Commission for the Preservation of the Natural and Historical Monuments, Relics and Antiques (Notices No. 1571 and No. 1572, *Gazette of the Government of the Union of South Africa*, Sept. 20, 1938, No. 2569, pp. 955–958). The orders are made under the provisions of Section 10 of the Natural and Historical Monuments, Reliques and Antiques Act, 1934, as amended by Section 4 of the Natural Monuments Amendment Act, 1937. The antiquities covered are specifically stated to be drawings, paintings, and petroglyphs of the Bushmen, or other aboriginals, or peoples inhabiting South Africa prior to the arrival of the Europeans, implements or ornaments known or commonly believed to have been used by them, and any anthropological or archæological contents of the graves, caves, rock shelters, middens or shell mounds, and any vertebrate fossil. Further, the orders cover any objects that have been proclaimed, or are capable of proclamation, as antique.

While the Commission thus entrusted with the responsibility of deciding to whom permits shall be accorded under the orders, is most anxious to encourage the exploration of the rich archæological and palæontological fields of the Union of South Africa, and welcomes research by all who are properly equipped, it is determined to do everything in its power to ensure proper investigation and to put an end to such reckless exploitation—often unwitting—as has been all too common in the part. With this object the orders now published embody by-laws which lay down regulations upon which the consent of the Commission to the excavation or removal of relics is made dependent.

These regulations prescribe the terms of the application, which must define the character of the antiquities and their exact location with a locality sketch of the area, and require that after removal the Commission shall be furnished with a description of the objects removed, a statement of their destination, and when the investigation is archæological, a complete set of plans and stratigraphical records. Further, the excavator may not dispose of any object without the written consent of the Commission by whom is also reserved the right to retain in South Africa a representative collection of the excavator's finds. While the right of scientific ownership is recognized, this may lapse if suitable publication does not follow within such time as the Commission may approve.

In order to ensure the proper character and technique of the excavation, not only must the application to investigate set out the applicant's credentials, but also access to the excavation is reserved to the Commission or its representatives; uncivilized labour must be properly supervised, all material must be sieved through a prescribed size of mesh, and photographs of material *in situ*, and of sections of stratified deposits must be submitted with notes to the Commission as soon as possible. Finally, not only must a witness section be left intact, but also not more than one half of any known area of a site shall be demolished, removed or excavated without the specific authority of the Commission.

The regulations, though drastic, are such as no archæologist could fail to approve. It is eminently reasonable that the South African authorities should seek to protect their antiquities from the fate by which other countries too often have suffered, owing to the removal from its place of origin of evidence of value, sometimes unique, of past cultural achievement. Even more important is it, especially in a country so sparsely populated and so difficult for supervision, as South Africa, to secure that antiquities are not wantonly despoiled, either through ignorance or through the indiscriminate greed of the curio hunter, but that when they must be made the subject of investigation in the interests of science, their evidence should be made available for the advancement of learning by examination under supervision in accordance with an approved scientific technique and by fully qualified and responsible investigators. The provision that part of any excavated site, unless otherwise determined, must be left undisturbed, is especially commendable.

Science News a Century Ago

The English Agricultural Society

THE first general meeting of the English Agricultural Society since its formation took place on December 18, 1838, Earl Spencer being in the chair. The committee, it was stated, had agreed to publish a quarterly journal of its proceedings and this would contain prize essays. It was desirous of enlisting all the talent it could for the discussion of subjects of deep interest to the practical farmer. An award for that year was being given to the Rev. W. Pearse, of Winkfield, Berkshire, for an essay on the cheapest and simplest process for analysing soils. The essays sent in on the origin and progress of the black caterpillar, the present state of agricultural mechanics and the improvement of implements had not come up to the required standard. One prize to be given at the Oxford meeting in July 1839 would be for an essay in the cultivation of the soil for cattle and breeding of stock. A veterinary college had long been established in London, and the committee had represented that great advantages would accrue if the College, instead of confining its attention to horses, would inquire into the diseases of cattle, sheep and pigs. A favourable reply had been received from the College by the committee.

Naval Architects in the Royal Dockyards

UNDER the heading "The Admiralty and the Members of the School of Naval Architecture", *The Times* on December 21, 1838, published a contribution from a correspondent referring to the dissatisfaction among the naval architects who had been trained in the School at the lack of recognition they received. The School, which was the first of its kind in Great Britain, was in existence from 1811 until 1832, having been founded as a result of the findings of Lord Barham's Commission of 1806. Those who entered the School had been induced to do so by promises held out by the Government that after proper examinations they would be eligible for the positions of foremen, assistant master shipwrights and master shipwrights in the dockyards. An Order in Council of January 30, 1816, had stated that the object of the School was to introduce a better and more skilful description of shipwright officers into H.M. Service. Those who qualified were under a bond of £500 to remain in the public service for at least ten years after the completion of their apprenticeship. Official countenance, however, was uniformly withheld from members of the School, and out of the last twelve appointments superior to that of foreman, said the writer, only one had been conferred on a past student.

The history of the School and the careers of those who passed through it were dealt with by the late Sir A. W. Johns in articles in *Engineering* of March 12 and 26 and April 9, 1926.

Technical Education at King's College, London

IN its "Weekly Gossip" column, the *Athenæum* of December 22, 1838, said: "Having so frequently advocated the cause of an improved system of education . . . it is with no little interest that we have watched those demonstrations which have been of late made in London, Durham, Dublin and elsewhere, in favour of methods of elementary instruction having for their basis the great principles of manufacturing and commercial science, and systems proposing to themselves the practical development of these, and their application to the processes of the commercial and manufacturing arts . . . and we are pleased to hear that the Council of King's College, in addition to the well-organised system of instruction to which we lately alluded, have recently added a teacher in Mineralogy; and yet further to determine the practical direction of their course, have at a recent meeting, assigned fees for the formation of one, if not two, additional professorships, of an exclusively practical nature, having for their object the development of the *Economy* of the mechanical arts, and the *Composition* of machinery. An arrangement has also been made, as we are informed, by which students who have attained a certain stage of their progress will be secured admission to various manufactories and public works carried on in the neighbourhood of the metropolis."

Discovery of Roman Skeletons

THE *Gentleman's Magazine* of December 1838 contains the following information: "Some interesting discoveries have been recently made at Shooter's Hill, near Pangbourne, Berks, on the line of the Great Western Railway. Several human skeletons, in a high state of preservation, have been disinterned, together with small sepulchral urns, of rude workmanship, but elegant and classical devices, and upwards of 40 Roman coins, of gold, silver and brass of reigns of Domitian, Constantine, Julian the Apostate, Constantius, Gracianus, Licinius or Lupicinius the Pro-Praetor (who was invested with regal authority), and several others. Spear-heads, battle-axes and spears of British and Roman manufacture were also found; and some of the graves contained considerable masses of charcoal, without bones. The bones are well preserved, having laid in dry gravel, about 4 feet from the surface, immediately overlaying the chalk; and one of the skulls appears heavier and more consolidated than is natural."

University Events

DUBLIN.—On December 8, the honorary degree of D.Sc. of Trinity College was conferred on Dr. R. Lloyd Præger, formerly librarian of the National Library of Ireland, and Prof. E. S. Goodrich, professor of zoology and comparative anatomy in the University of Oxford.

DURHAM.—Dr. F. A. Paneth, reader in atomic chemistry in the University of London, has been appointed professor of chemistry in the Durham Division, vacant by the appointment of Prof. Irvine Masson to be Vice-Chancellor of the University of Sheffield.

LONDON.—Mr. E. R. J. Hussey has been appointed as a third Heath Clerk lecturer for 1938–39.

SHEFFIELD.—The following resignations have been recently received: Dr. Arthur Pool, from his post of lecturer in mental diseases; Mr. A. W. Fawcett, from his post of lecturer in surgical pathology; Mr. H. E. Collins, from his post of lecturer in mining.

Societies and Academies

Edinburgh

Royal Society, November 7

A. D. PEACOCK and ANN R. SANDERSON: The cytology of the thelytokously parthenogenetic saw-fly, *Thrinax macula* Kl. The fern-living saw-fly, *Thrinax macula* Kl., in the laboratory at least, reproduces solely by females. All-male, or predominantly all-male, broods occasionally appear under parthenogenesis, but the males so far appear to be reproductively useless. The female somatic and germ tissue constitution is 14, that of the male spermatogonium and spermatocyte counts, 7. Autoregulation of chromosome number in the parthenogenetic female-producing egg shows only one maturation division, non-reductional, and the formation of only one polar nucleus.

MARY H. LATHAM: Some Eocene Ostracoda from North-West India. The collections of Eocene Ostracoda described in this paper were made by Lieut.-Colonel L. M. Davies and by Mr. Pinfold of the Attock Oil Company. The specimens are of particular interest and importance owing to the fact that very few fossil Entomostraca had previously been found in India. Both Bairdiidæ and Cytheridæ are especially abundant in beds of Upper Ranikot age in the Punjab and Attock districts. It therefore becomes evident that these beds were of a predominantly estuarine facies. During the later Palæocene and the Lower and Middle Eocene times, Ostracoda became exceedingly rare and small probably owing to the extension of marine conditions.

W. PEDDIE: Establishment of the trichromatic theory of colour vision. The various points on which misunderstanding arose regarding the essential implications of the trichromatic theory were reviewed. Inessential postulates were frequently looked upon as fundamental, although they were only introduced for purposes of ready description. Again, postulates introduced only as being the most simple, to be retained only so long as no occasion for expansion arose, were taken as necessary. The latest of these was the postulate regarding the magnitudes of the component colour vectors, which has been amended by Schroedinger. Three independent stimuli are now universely recognized as sufficient. So three sensations follow logically, and trichromasy is established.

B. N. DESAI, P. M. BARVE and Y. S. PARANJPE: Importance of dialysis in the study of colloids. (5) Colloidal gold. (6) Colloidal vanadium pentoxide. The cataphoretic velocity of the particles in gold and vanadium pentoxide hydrosols, and their tendency to aggregate in the presence of electrolytes, are markedly dependent upon the extent to which the sols are dialysed. Hence certain apparent anomalies may be attributed to disregard of the influence of dialysis. The behaviour of the sols on dialysis and dilution shows that the properties of such systems are not related in the simple fashion frequently postulated. In particular, it would appear that the stability does not depend directly upon the magnitude of the particle charge.

IAN SANDEMAN: Molecular spectra of the hydrogen isotopes. (1) Application of the rotating vibrator model to the states of D_2. Measurements of some of the band systems of deuterium in the visible part of the spectrum are now available from the work of G. H. Dieke and his collaborators. Difficulties raised by the practical application of the theoretical work of the late J. L. Dunham to the spectrum of the neutral molecule of deuterium are discussed, and the constants of two of the molecular states are calculated and compared with those for the corresponding states of the neutral hydrogen molecule. It is shown that the potential functions of the two isotopes differ considerably and that the equilibrium internuclear distance is greater for hydrogen than for deuterium at least in one of the states considered. The results of the analysis are sufficiently consistent to indicate that in states of the type considered the rotating-vibrator model provides an accurate means of spectral analysis and opens up new avenues for investigation.

G. N. WATSON: The computation of the error function.

T. M. MACROBERT: Solution in multiple series of a type of generalized hypergeometric equation. Those generalized hypergeometric equations which are of the same type as the ordinary hypergeometric equation have solutions in terms of generalized hypergeometric functions in the domains of the origin and of infinity. This is also the case for the ordinary hypergeometric equation in the domain of the unit point; but it is not true there for the generalized equations. In this paper solutions for these equations in the domain of the unit point are obtained in the form of multiple series.

Paris

Academy of Sciences (*C.R.*, 207, 949–1020, Nov. 21, 1938).

G. BERTRAND and G. BROOKS: Methoxyl content of lignified tissues.

G. GIRAUD: Derivatives of functions which correspond to a problem of the Dirichlet type.

L. DANIEL: Two curious cases of vegetative revival.

L. HIBBERT: Curves of equal argument: univalent cellules, inversion of *fonctions entières*.

L. TCHAKALOFF: Some properties of the gamma function.

L. GOLDSTEIN: Statistical interpretation of the recombination of atomic nuclei.

MLLE. N. MORGULEFF: Research on cyanogen in stars of types *K*0 and *A*0.

G. GARCIA and A. ROSENBLATT: Stokes's formula in the theory of gravity.

M. SCHLUMBERGER and V. BARANOV: Gravity anomalies in the region of Alençon.

MLLE. P. FÉVRIER: Kinematic geometry adapted to the theory of quanta.

J. LOISEAU: Remarks on the subject of the theory of relativity and the representation of phenomena in space of four dimensions.

A. DATZEFF: Stable orbits in a reduced problem of three bodies.

P. CHAVASSE: Measurement of the acoustic time of reverberation.

E. HOCHARD: Artificial modification of certain constants of a galvanometer.

A. OLLIVIER: Evaluation of the specific magnetic rotatory powers of dissolved ferric nitrate and of ceric sulphate.

V. DOLEJŠEK and M. JEŽEK: The separating power and the penetration of X-rays in mosaic crystals.

V. KARPEN: Adherence of the framework to the concrete in reinforced concrete.

MLLE. H. THI NGA: Reduction of orange 2 and of methanile yellow at the dropping mercury electrode.

W. HELLER and E. VASSY: Remarks on the action of alcohol on colloidal systems with hydrophile particles.

MME. R. DUVAL and C. DUVAL: A sodium cobaltopyrophosphate.

E. GRILLOT: Neutral and basic lead monochlorethanoates.

E. CATTELAIN: Some derivatives of β-[4-methoxyphenyl] methylpyruvic acid.

E. RAGUIN: Age of the granitic rocks in the Pyrenees.

C. FRANCIS-BOEUF: Data on the transparency of the maritime Aulne at Trégarvan. Such measurements can be used to study the currents of this river.

J.-L. PERROT and M. PERROT: Chromosomes of the genus *Helix*. The chromosome number of this genus is 27, not 12 or 24 as has been reported by earlier investigators.

M.-L. ROCCO: Metabolism of compounds of purine origin in insects. Excretion of uric acid is not the general rule; the acid, as in vertebrates, is generally degraded by enzyme action to allantoin or allantoic acid.

MLLE. C.-T. BAUDOUY: Formation of ovokeratin in *Raja batis*.

L. BOUNOURE: Segregation of the germinal layers, and the general problem of embryonic segregation.

R. LECOQ and R. DUFFAU: Influence of conditions producing total avitaminosis B or mineral disequilibrium on the composition of the muscle of the pigeon.

RAYMOND-HAMET: Hypotensor and vasodilator effects of cryptolepine, an alkaloid extracted from *Cryptolepis sanguinolenta* Schlechter.

R. CHAUVIN: Reddening of the migratory cricket. The cricket and other acridians have beneath the skin a yellow compound which becomes red on reduction.

Vienna

Academy of Sciences, October 20.

E. SPÄTH: Peganin (vasicin) (13). A review of recent work on this alkaloid.

F. GALINOVSKY and H. BRETSCHNEIDER: Thermal decomposition of cholestenonpinacone.

HERTA SCHEICHENBERGER: Production of artificial radioactivity in europium, rubidium and cæsium by irradiation with neutrons. In the case of europium, β-activities with half periods of 9·2 hours and 1·2 years were found. Rubidium gave β-activities with half periods of 18 minutes and 18 days, while cæsium gave an activity with a half period of about a year. The percentages of these activities which are due to thermal neutrons were found.

A. SKRABAL: Rate of formation of chlorate in bleaching solution.

H. BENNDORF and E. RUMPF: Badly conducting surface layers on apparently clean metals, and their effect on the operation of sensitive electrometers. Instability of the zero of a string electrometer is ascribed to a badly conducting layer on the surface of the fibre, which can retain charges and has a variable contact potential to the other electrodes.

H. SEELMEIER: Occurrence of diabase on the Christophberg at Klagenfurt.

R. KNEBEL: Geological profile of the Kehr anticline (southern slope of the Pleschkogel at Graz).

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

LECTURER IN MECHANICAL ENGINEERING in the Burnley Municipal Technical College—The Director of Education, Education Offices, Burnley (December 22).

CHEMIST in the Ordnance Factory, Irvine, Ayrshire—The Under-Secretary of State (C.5), The War Office, London, S.W.1 (Quote Appts. 112. December 23).

DIRECTOR OF WATER EXAMINATION to the Metropolitan Water Board—The Acting Clerk, Offices of the Board, 173, Rosebery Avenue, E.C.1 (December 31).

INSPECTOR OF AGRICULTURAL AND HORTICULTURAL EDUCATION AND RESEARCH, Ministry of Agriculture and Fisheries—The Secretary, 10 Whitehall Place, S.W.1 (December 31).

ASSISTANT TO THE ADVISORY CHEMIST, Department of Agriculture, University of Cambridge—The Secretary (January 7).

SECRETARY of the Institution of Electrical Engineers—The Chairman of the Selection Committee (February 1).

LECTURER IN GEOGRAPHY in the Portsmouth Municipal College—The Registrar.

PROFESSOR OF ZOOLOGY in the University of Reading—The Registrar.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Annals of the Cape Observatory. Vol. 14, Part 3: Stellar Parallaxes (2nd Series) determined in the Years 1928–1931 with the Victoria Telescope of the Royal Observatory, Cape of Good Hope, under the direction of Dr. H. Spencer Jones. Completed for publication under the direction of Dr. J. Jackson. Pp. xi+109. (London: H.M. Stationery Office.) 11*s.* net. [2211

Tuberculosis in Cyprus: an Interim Report on its Incidence and Means of Control made under the auspices of the National Association for the Prevention of Tuberculosis. By Dr. Noel Dean Bardswell. Pp. vi+228. (London: Adlard and Son, Ltd.) 2*s.* 6*d.* [2211

Tuberculosis, Cancer and Zinc: an Hypothesis. By Douglas Barron Cruickshank. Pp. xv+75. (Papworth: Sims Woodhead Memorial Laboratory.) [2211

Board of Education: Science Museum. Science in the Army: a Brief Account of the Scientific Training and Technical Work of the Soldier To-day, as illustrated by a special War Office Exhibition held at the Science Museum, November 1938–February 1939. By Anthony Armstrong. Pp. 20+3 plates. (London: H.M. Stationery Office.) 6*d.* net. [2211

Proceedings of the Royal Society of Edinburgh, Session 1937–1938. Vol. 58, Part 3, No. 16: Two Cases of Malformation of the Gill-covers in Salmon. By Dr. V. Tchernavin. Pp. 233–241+1 plate. 1*s.* Vol. 58, Part 3, No. 17: The Dynamics of Sheet Intrusion. By Dr. E. M. Anderson. Pp. 242–251. 1*s.* (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [2311

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1816 (2522): Full Scale Tests of the Airspeed Envoy Type A.S.6.G. By J. E. Serby, R. H. Francis and P. Fortescue. Pp. 10. 1*s.* 6*d.* net. No. 1825 (3361 and a): Diffusion of Load in certain Sheet-Stringer Combinations. By Dr. W. J. Duncan; with an Appendix by H. L. Cox. Pp. 15. 2*s.* 6*d.* net. No. 1827 (3366): The Use of the Principle of Minimum Potential Energy in Problems of Static Equilibrium. By D. Williams. Pp. 18. 2*s.* 6*d.* net. No. 1829 (3066): Measurements of Accelerations at Different Parts of a Boat Seaplane during Take-off and Landing. By G. C. Abel. Pp. 12. 2*s.* 6*d.* net. No. 1830 (2775): Stressed-skin Structures—Compression Tests of Panels with Tubular Stiffeners. By I. J. Gerard and Dr. B. G. Dickens. Pp. 28. 4*s.* net. (London: H.M. Stationery Office.) [2311

Other Countries

India Meteorological Department. Scientific Notes, Vol. 7, No. 78: Temperatures and Humidities up to 3 kms. over Karachi. By P. R. Krishna Rao and K. L. Bhatia. Pp. 119–130+3 plates. (Delhi: Manager of Publications.) 9 annas; 10*d.* [2111

Division of Fish and Game of California: Bureau of Marine Fisheries. Fish Bulletin No. 52: Historical Account of the Los Angeles Mackerel Fishery. By Richard S. Croker. Pp. 62. (Terminal Island: California State Fisheries Laboratory.) Free. [2111

Conseil Permanent International pour l'Exploration de la Mer. Faune ichthyologique de l'Atlantique nord. Publiée sous la direction de Prof. Joubin. No. 18. 24 plates. (Copenhague: Andr. Fred. Høst et fils.) 4.00 kr. [2211

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 183: The Control of Peach Mildew. By Dr. Amin Fikry. Pp. ii+14+7 plates. F.T.3. Bulletin No. 208: Two Genera and Species of Aphids new to Science. By Dr. Labib B. Soliman. Pp. ii+6+8 plates. F.T.5. (Cairo: Government Press.) [2211

Scientiæ Naturalis Bibliographia. Ed.: W. Junk. Annus 2: 1938. Pars 1. Pp. 80. (Den Haag: Dr. W. Junk.) 3 fl. (6*s.* 9*d.*) a year. [2211

Tanganyika Territory: Department of Lands and Mines, Geological Division. Short Paper No. 20: The Geology of Parts of the Tabora, Kigoma and Ufipa Districts, North-West Lake Rukwa. By G. M. Stockley. Pp. 35. (Dar es Salaam: Government Printer.) 3*s.* [2311